JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

MARCH, 1834.

Remarks, by the Editor, on a patent for "Discoveries in Natural Philosophy, reduced to practice," made by the late Horatio Gates Spafford, of Lansingburg, New York. Granted in pursuance of a special Act of Congress, passed July 3d, 1832; issued July 5th, 1833.

We promised in our last number to publish some remarks upon the above patent, and this promise we now proceed to redeem. The act of Congress under which it was granted will be found at page 2, of vol xi, accompanied by some remarks, indicating that we had become acquainted with the supposed discovery of the applicant; we say *supposed*, because we have no doubt that when the thing was first proposed, it was believed to be founded on correct principles, although, as we shall prove, such an idea is without any foundation in "Natural Philosophy."

It is unnecessary to name the two gentlemen from whom the information of which we are possessed, was derived; they, however, are residents of the city of Philadelphia, and one of them, at least, has paid a high price for his knowledge: to each of them Mr. Spafford had communicated his whole plan, without the slightest obligation of secrecy. One of these gentleman, governed more by the confidence which he placed in the projector, than by careful investigation, was, for a while, lead away by it; the other, a professed mechanician, perceived at once the fallacy of the thing proposed, and in order to render this evident to the projector, a model was actually constructed, which, if

conviction had been possible, would have demonstrated to him the hollowness of the whole scheme.

We most sincerely wish, that it was in our power to give a more favourable opinion of this pretended discovery; for independently of the benefit which would be derived from it by the heirs of the deceased, were it valid, its advantages to the public would be incalculable, and it would make a new era in the progress of the useful arts. We are unwilling, also, to dissent from the opinions so confidently entertained by some highly respectable individuals, whose names had a well deserved influence with the committee who reported the bill, which was eventually passed by Congress into a law. In the certificates given, it was declared that the discovery embraced a new principle in mechanical power, the application of which was more important to the interests and honour of the country, than any other discovery made since we have been a nation. An opinion was also given that it would prove to be ten times more valuable than the exclusive use of steam power, in any country. How many of the individuals who furnished such opinions two or three years ago, still retain them, we do not know; but we are very apprehensive, that some of them, at least, would be more than willing to withdraw their endorsement.

There is one feature in this contrivance, which assimilates it to all the schemes of perpetual motion which have been devised, and that is, that it at once contradicts the law, that action and reaction are equal, and exerted in contrary directions; there is, we know, a class of men who will not be startled at this, although they think that they know something about mechanics; we do not pretend to write for such persons, because we have not time to begin with them at the alphabet of the subject, and to accompany them until they have acquired some knowledge of the first principles of its grammar. The only successful teacher of men of this class, is experience, and even his lessons they rarely comprehend.

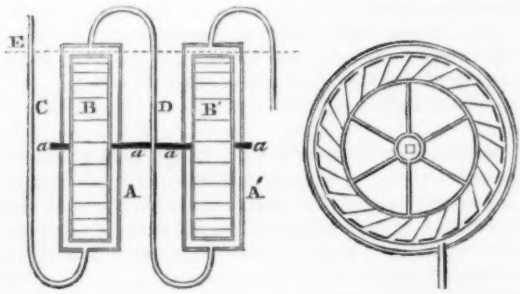
The mode of obtaining power which Mr. Spafford proposed to adopt, was the ascent of a lighter through a heavier fluid, during which ascent it should operate upon the floats of a wheel, and turn it by its ascending force, as water does by its descending power, in an overshot wheel. The wheel to be thus acted upon is to be enclosed in a tight cistern, or reservoir; and, supposing the heavier fluid to be water, and the lighter one air, the wheel is to be completely submersed in the former, leaving a space above it, as a chamber for the air. The air to be employed is first condensed by the aid of some apparatus adapted to that purpose, a portion of the *power which is to be gained* by the instrument being employed to effect the condensation; of this power, two or three per cent. is to be sufficient.

Various forms are proposed to be given to the machinery, according to the natures of the light and heavy fluids employed, and by the difference of whose specific gravities, the action is to be produced; for although we have hitherto spoken of cold water and air only, we understand that instead of these, hot water and steam are to be the acting fluids. In this case, the steam is to be generated in a boiler, surmounted by an air tight cylindrical case, within which there is to be

a wheel made like an overshot water wheel; this is to revolve in hot water, the generated steam being conducted under the buckets on one side, and discharged from them into a space above, forming a steam chamber. A pipe is to pass round from this steam chamber, to re-conduct the steam under the wheel, a circulation being kept up which is to cause the same steam to operate perpetually, with the assistance of that to be produced from the continuance of the fire.

We have seen several drawings, intended to illustrate the machinery, and give herewith a sketch of one of them, in which water and condensed air are to be used.

Fig. 1. *Fig.* 2.



A A', fig. 1, are two cases, which are to contain the wheels, B B', placed within them. The axes of these wheels, *a a*, must, of course, pass through stuffing boxes in the cases, so that any number of them may be connected together, and their concurrent action obtained. C, is a tube by which condensed air is to be conveyed from its reservoir, (which reservoir is not shown,) and under the buckets of the wheel, B, in the first of the series of cases; D, is a tube by which the air that has caused the first wheel to turn, is to be carried from the reservoir in the upper part of the case, to the under part of the next; and so through the whole series. Fig. 2, is a side view, in section, of one of the contained wheels, under the buckets of which, the air is to operate. In order to their working the more easily, these wheels are not to be heavier than the water in which they revolve, so that they may have little, or no, bearing upon their gudgeons.

That any person, having any pretensions to mechanical knowledge, should be, for a moment, deceived by such a plan of obtaining power, would be incredible, were the fact not proved by the incontrovertible testimony of the names of the persons themselves. So far as testimonials are concerned, there was much presented to Congress, to warrant the passing of the special act under which this patent was granted. Several of the certificates, it is true, are from persons who do not pretend to sustain the invention in all its allegations, but they still go to prove that the power, as employed, is a new principle in hydraulics; and most of them, as we have already stated, express their

conviction, that it will supersede, or nearly supersede, every other plan of driving machinery.

Why it was proposed to use condensed air, we have never been informed, and should be at a loss to divine the reason of it, from the simple argument that the motive power originates in the difference in the specific gravities of the two fluids employed; for if the air is condensed, this difference is lessened, and, of course, the effect diminished in the same proportion. We, it is true, have our conjectures upon the subject, and they are these; on trying the experiment upon the model, with air of the ordinary density, it has been found that it required as much, and indeed more, force to inject it into the buckets, than it was capable of exerting after it was there; condensed air was then tried, and it was found that when *sufficiently condensed*, it would actually pass into the buckets by its own elasticity; no account, however, was taken of the expenditure of power in condensing this air, a thing which it was both easy and convenient to omit: had this been carefully attended to, the result would have been the same as that with uncondensed air; instead of a gain, there would have been a loss of power.

Let the dotted line E represent the height of the water in the cylindrical cases, or cisterns, A A′, and it will, of course, rise to the same height in the supply pipe C; to enable the water in this pipe to overcome the pressure of the column in A, its surface must be acted on with a force equal to that pressure, which force must be continued during the whole time the air is entering; consequently, air of the common density cannot be employed. To overcome this difficulty, let us imagine condensed air to be used, agreeably to the plan under consideration; this condensed air, if the plan be correct, must be capable of operating upon a hundred such enclosed wheels, without any sensible diminution of its elasticity. For this to take place, the air, after it left the first wheel, and arrived above the dotted line in the first cistern, would press upon the surface of the water in it, with a force equal to that of the condensed air in the pipe C, and as these two forces would counterbalance each other, there would be no motion, and the water would rise in that pipe to the dotted line. The communication between A and A′, by means of the pipe D, would not alter this state of things, for fluids press equally in all directions; its pressure upon the water in A, would not, therefore, be lessened by its escape into A′, because a like quantity is to be perpetually supplied, by the revolving of the wheel, to keep up the tension, without which the whole plan would be nugatory.

The question, what is to be the final disposition of this condensed air, will here very naturally be propounded; it was so by us when the nature of this pretended discovery was first explained to us. The reply is, that, of course, after having been allowed to turn fifty or a hundred wheels, it must escape, and, in the mean time, a new and equal portion must be condensed. To show the extent to which the condensation must be carried, in order to enable the air to escape through a hundred cisterns, we will assume that the contained wheels are ten feet in height, which, we apprehend, would be a moderate diameter, if

it were wished to employ the power to any advantage. This would give a column of water of a thousand feet in height, equal to thirty atmospheres, or to a pressure of 450 lbs. upon every square inch. And even this, enormous as it is, would produce no effect whatever, as it would amount to nothing more than a mere counterpoise for the water, it must therefore be carried to a much greater extent to become operative.

We feel inclined to ask pardon of most of our readers, for occupying so much of our space, and of their time, in exposing the fallacy of a thing so manifestly absurd; we will not, therefore, extend the investigation for the purpose of proving that which must, we think, be obvious to every one who is capable of being convinced. But for the particular circumstances under which this thing has been brought before us, the whole scheme would, probably, have been deemed unworthy of any serious examination; the editor of the Journal of the Franklin Institute must, however, consider himself as a public sentinel in such cases, and would be wholly unworthy of the station which he occupies, were he to withhold that information which may prevent the unwary from being led astray by schemes presented to them under a specious aspect; and with the supposed sanctions of a special law, and a public patent. It should be remembered, however, that the law and the patent, are both exparte instruments; the law is passed because the names of those who are supposed to understand the thing in favour of which it is asked, are appended to certificates which appear to render it proper, and the patent follows as a thing of course. We should think it wrong to give, here, the names of those to whose certificates we have alluded, because we have no doubt that the most intelligent of them would gladly have them withdrawn; and now really regret that, in one instance at least, they have manifested less judgment than kindness.

It is scarcely worth while to inquire into the novelty of that which is useless, but we will remark, that a patent was obtained by a Mr. Doll, about eight years ago, for driving a similar wheel by steam, to be applied to it within a reservoir, the wheel being constructed like that proposed by Mr. Spafford. And previously to this, Mr. Genet had obtained his patent for his applications of the "upward forces of fluids," on which subject he published a memorial in the year 1825, which was animadverted upon in the Franklin Journal, for August and September, 1827.

The following quotation from the preface to the second volume of Desagulier's Experimental Philosophy, published in the year 1743, appears so apposite, that we have determined to borrow it for the closing paragraphs of the present article.

"About two years ago, a man proposed an engine to raise by one man's work, about ten times more water than was possible, to a certain height, in a certain time; for which he wanted an act of Parliament, and got a report of the committee appointed to examine the matter, *that he had made out the allegation of his petition.* If this had passed, a great many persons were ready to subscribe a consi-

derable sum to the project; which money, of course, would all have been lost, and perhaps some families ruined; but a nobleman who understands the nature of engines very well, knowing the impossibility of what was proposed, threw out the bill.

"Our legislators may make laws to govern us, repeal some, and enact others, and we must obey them; but they cannot alter the laws of nature, nor add, or take away, one iota from the gravity of bodies."

Remarks on Kugler's *Planing Machine.*

We noticed this planing machine in the last volume of our Journal, p. 394, and in our notice expressed a fear that the resistance opposed to the motion of the board, by the simultaneous action of the great number of plane irons employed in it, would, especially on cross grained stuff, be so great as to interfere with its utility. Although we have not yet had an opportunity of seeing the machine in action, we have conversed with gentlemen of intelligence who were interested in the discovery of any objections to which it was liable, and whose account of it is such as to show that our apprehensions were altogether unfounded.

We have made the following memorandum of the information communicated, of the absolute and entire truth of which we cannot entertain the slightest doubt. Its ordinary rate of working is the planing, tongueing, and grooving, of six flooring boards, twenty-four feet long, in a minute, or of a corresponding number of those which are shorter. It appears to meet with no difficulty from such as are knotty, or cross grained, the angular direction of the irons causing them to cut without the slightest tearing. The machine, it appears, will take off twenty-three shavings from the top, and an equal number from each side, at one operation.

The inquiries of the gentlemen to whom we alluded in the commencement of this article, were directed solely to the ascertaining of the originality of the invention, in those particulars which constitute the claim; a point upon which we did not entertain any doubt whatever, and it is to us a source of unmixed pleasure, to find that we were incorrect in the only doubt which we did entertain, namely, that respecting the practical operation of the machine.

Editor.

On the principles which determine the Hardness of Iron Castings, and the mode of selecting the different varieties required by the mechanist. *By* Rufus Tyler, *Mechanist.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Estimating highly the importance to the practical mechanic and to science, of a mutual interchange of ideas and observations, through the medium of this Journal, I beg leave to offer for

your disposal, the following remarks, drawn from many years experience, relative to cast iron, and its application in the construction of machinery.

Formerly, mechanists experienced much difficulty in procuring iron castings of sufficient softness to admit of being worked with any facility, and even at the present day, the art of producing castings of any desired quality, is involved in some degree of obscurity. I shall endeavour, in my communication, to remove this obscurity, and thus to enable the founder to economise metal, and to assist mechanists in determining with readiness and accuracy, the fitness of any casting which may be offered to them.

It is usual to distinguish the hardest and softest kinds of cast iron, by the terms white and black, and all intermediate degrees by the term grey. The darker shades indicate the greater proportions of carbon which the material contains, and are most highly valued for melting, as a portion of this substance is unavoidably lost in that operation.

These indications, so far as the different shades of grey actually appear, may generally be relied upon for determining the quality of any article under examination; but circumstances incident to the casting, may cause each and all of them to assume the appearance and properties of the white variety, from which they cannot afterwards be distinguished, except by annealing, by remelting, or by chemical analysis. It is a mistake, therefore, to attribute to a deficiency of carbon, as is almost universally done, properties common to castings of every degree of carbonization; properties which will be found upon investigation, to depend upon *the particular arrangement of the particles*, assumed in passing from the fluid to the solid state, *determined by the length of time occupied in cooling, and by the proportion of carbon, conjointly.*

It is a fact, with which every workman in this material is familiarly acquainted, that opposite qualities are frequently exhibited in different parts of the same piece of casting. This is generally supposed to arise from an unequal distribution of the carbon, caused by the more rapid cooling of the thinner parts, which are always the first to assume the crystalline form. Hence it is the universal practice among founders, in making selections for melting, to break off and reject the hard parts, and to retain those which are soft for producing soft castings, and vice versa, for hard. In reality, every piece of cast iron, appearances to the contrary notwithstanding, is of the same composition throughout; and, further, it is only from such pieces as present both the hard and soft form, that an accurate knowledge can be obtained of the qualities of the material by inspection.

A knowledge of this fact, is of the utmost importance to founders, since under their present mistaken views, they are liable not only to undervalue much of their best material, because of its close resemblance to that which is inferior, but whenever this same supposed hard metal is employed for casting articles in which extreme hardness is a principal requisite, a disappointment necessarily results, except in

castings which happen to be as thin as those from which the selection for the furnace has been made. As it frequently happens that a charge is made up of both *real* and *supposed* hard iron, the result is seldom so totally at variance with what is expected, as in the case which I have just supposed. It is, however, in general sufficiently so to call forth the usual explanation, namely, that the metal has been improved, that is, has received an accession of carbon, in the furnace, although the reverse is known to take place generally, and to such an extent, that after metal of the softest quality has been remelted half a dozen times, it is no longer fit for any but the hardest castings; indeed, an allowance for this must always be made, particularly in the common air furnace, which hardens metal more than the cupola or blast furnace.

In attempting to produce extreme hardness, in thick masses, there is a difficulty in addition to that of the improper selection of metal. The high melting point of the metal, suitable for such purposes, produces this difficulty, which is further increased by the necessity of choosing from masses, as large, at least, as those which it is intended to produce. This, however, will not be regarded as an inconvenience, by those who are not aware that *hard* metal, in the form of thin scraps, may, or may not, produce hard castings, of larger, or rather of thicker, masses, at least by those who not having very powerful furnaces, reject large masses altogether. It is probably owing to this circumstance, together with the want of correct theory, that recourse is generally had to the artificial "chill," for hardening anvil faces, and many similar articles, thereby causing the metal to consolidate within the *hardening limit of time.*

By the employment of metal found to be truly hard, in pieces as large as can be conveniently managed, there will be no need of chilling any castings, smaller than those from which such selections have been made.

Some years ago, a notice went the rounds of the journals, of the discovery that hard cast iron, might be rendered quite soft by annealing in sugar.

I have before stated, that castings having different proportions of carbon, but resembling each other in being very hard, may be distinguished from each other by annealing; the fact is, that iron, highly carbonized, but hard from being chilled, or from being cast in very thin plates, may be softened by a simple annealing, and this may account for its working so *sweetly*, as your worthy Editor would say, after sugaring, as I did not find that experiment to succeed in a trial to which I subjected a piece of my own selecting.

Those who suppose that there is an unequal distribution of the carbon, in pieces which are soft and hard in spots, are answered by asking, what becomes of the carbon when a piece which would otherwise be grey and soft, is chilled in such a manner as to be rendered white and hard throughout, under circumstances which do not well admit the supposition, that the carbon has escaped? For instance, let a hole, half an inch in diameter, be drilled six or more inches deep, in a large block of brass, we must avoid cast iron, for that might

be said to absorb the carbon, and filled with melted iron. Now no one can doubt, that, in this case, the casting would be hardened through. It is necessary, therefore, to seek for some other theory than the one just mentioned, to account for this phenomenon. The one which I have adopted, as before stated, supposes, that whenever such a result takes place, it is due to circumstances in the *time of cooling;* in other words, that every piece of casting, whether white or grey, being remelted without changing the proportions of carbon and iron, will reproduce the same quality, if the time occupied in congealing be the same as before.

According to this theory, every different quality of cast iron, has *its own rate of cooling*, which determines the character it will assume. To illustrate this point, after I had long known the fact, I had a pattern made, consisting of two wedges, as nearly alike as possible; being about two inches wide, by three in length, and tapering from half an inch thick at the back to as thin an edge as could well be cast in the usual moulds of sand. These wedges were then connected at their backs by a piece as wide as one of the wedges, and about half an inch in thickness, in such a manner as to insure equality in moulding and casting in all respects: the edges being downward in the mould, caused them to fill, by pressure, very perfectly. From this pattern, or double wedge, I procured castings of various qualities of metal, from very soft, and highly carbonized, to that which was of a medium quality, (degree of carbonization,) and when broken diagonally across, one of the wedges of each pair from the edge towards the back, exhibited in the same fracture both the white and grey iron. In each, the white always commenced at the edge, and extended towards the back, where it met the grey, the transition being sudden, and tolerably well defined, but varying in *distance* from the edge, with the *shade* of grey, and thus furnishing a relative scale of measurement of the different qualities of the material.

This line of transition was found to follow very accurately the line of equal thickness, or, which is the same thing, of equal distance from the edge, across the wedge from side to side. The same appearance was exhibited by the other wedge of the pair, as was anticipated; and any number of similar wedges, cast under the same circumstances, of the same metal, whether connected or not, would exactly coincide, the time of cooling being the same in each.

From these facts, it is manifest that nothing more is necessary to enable one to determine the precise hardness of any casting, without defacing it, than to search out some thin wedge shaped part which may be broken off without injury; a wedge may be previously attached to the pattern, for the purpose, from any one of the castings made at the same time, of the same metal; and by noting the thickness at which the white form, passes into grey, having previous knowledge of the quality due to that thickness.

An exception to this rule, will be found in the last running of a heat, which is always harder than the first, the reason of which is, that the metal goes into the mould, at a temperature considerably

lower than at first, and consequently does not heat it to the same degree, and therefore the time of cooling of the metal, will be less for a given thickness.

Subsequently to the experiment before mentioned, I procured some pieces of different kinds of iron, cast from a pattern in the form of a cup, the rim of which was wedge shaped, instead of the double wedge, as being free from an objection which ought to have been mentioned in its proper place, to wit, that the edges being more exposed than the middle of the wedge, would cool sooner, and consequently remove the hardening point a little further up, making a slight variation in the line of transition, at those points.

It is probable, likewise, that these results would be slightly modified by another principle, which was indicated by the cast wedge; that in such forms as terminate every where by edges thicker than the hardening point, while portions are just inferior in thickness to that point, no hardening would take place; as the hard form, which is probably the result of crystallization, seems in this, as in other substances, to require some arrangement by which it may be commenced, and from which it will extend. Indeed, I have reason to believe, that where, from the nature of the furnace, or the metal employed, or from the acuteness of the angles in the pieces to be cast, danger is apprehended that the edges most exposed, will become hard for a small distance, that this result may be prevented entirely, by removing from the pattern these edges to *a less distance*. Such small portions may well be spared, even if recourse should afterwards be had to the file, or chisel, for restoring to the casting its proper form.

In the examination of a lot of castings at the foundry, care should be taken to avoid selecting such pieces, or parts, for breaking, as are likely to have had the rate of cooling affected by peculiar circumstances, such as the *gates*, (parts of which are either exposed to the atmosphere, or to sand immediately heated by the metal running over it,) or finny parts immediately in contact with large masses, which would cause them to remain longer in a fluid state. In this, there is seldom any difficulty, as there are generally to be found, for some days after any particular castings have been made, imperfect or damaged pieces, known to have been cast at the same time, upon which the examination can be made. Although wedge formed pieces, for reasons which must now be sufficiently obvious, are to be preferred, yet is often sufficient to examine the fracture of a piece of almost any shape, provided its time of cooling would be within that allowed to the thinnest portion of those to be determined; for the question, generally, is not, what is the precise quality, but whether castings are *soft enough* to admit of being worked.

Description of a Revolving Keeper Magnet, for producing Electrical Currents. By J. Saxton.

[Communicated by Professor A. D. Bache.]

Extract of a letter from J. Saxton of Philadelphia, now in London, to Isaiah Lukens, of Philadelphia.

"Since writing to you last, I have fitted up a magnet, which I believe produces much more powerful electrical effects than any other which has yet been made. It weighs five pounds and a quarter, and has a permanent power capable of supporting ten pounds. By the aid of this magnet, I can decompose water rapidly, and the shocks given to the tongue and mouth are so violent that few will take them a second time.

Fig. 1.

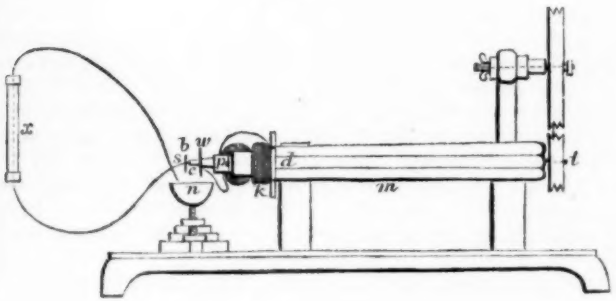


Fig. 2.

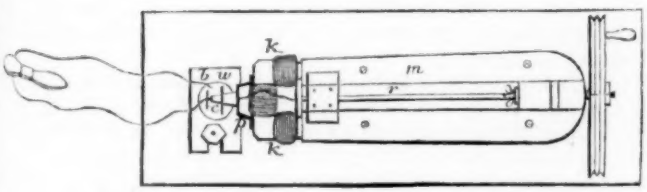


Fig. 3.

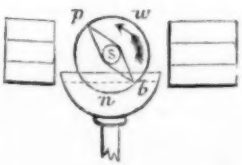
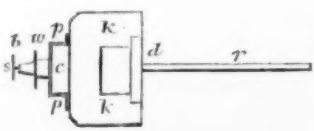


Fig. 4.



Of the accompanying figures, figure 1 is an elevation, and figure 2, a plan of the apparatus. In both figures, *m* represents the magnet; *k*, is the keeper, around which copper wire, wrapped with silk, is coiled; in the case above referred to, each of the three coils of wire contains eleven yards. The inner ends, or ends nearest the keeper, of the three coils, placed as shown in the figures, are united to a wire stem passing through a wooden cylinder *c*, firmly attached to the brass strap, or projection, *p*, which is screwed upon the keeper; upon the outer end of the stem *s*, fig. 3, screws a brass cross bar, a front view of which is shown at *b*. The outer ends of the same coils of wire, are soldered to a copper wheel *w*, fixed upon the wooden cylinder already described, which serves to insulate it from the copper stem *s*. The wheel *w*, dips into a wooden cup, *n*, (shown also in fig. 3,) containing mercury. [It is obvious that any electrical current in the wire will be continuous when the cross bar *b* (fig. 3,) dips into the mercury, and will be interrupted when the same bar leaves the mercury.] The proper position for the cross bar *b*, is that in which it is just leaving the mercury as the keeper arrives at the position in which its magnetism is neutralized. The keeper is made to revolve upon the ends of the magnet, and around its axis, by connecting it strongly by a brass disk *d*, with the rod *r*, turned by the wheel *t;* the velocity may be increased by the arangement shown in figs. 1 and 2, the two wheels being connected by a band or strap. The arrangement of the keeper with its strap *p*, of the wooden cylinder *c*, of the copper rod *s*, passing through its axis, and of the stem *r*, which serves to turn the keeper, are most fully shown in fig. 4; the keeper is represented without the wire upon it.

"The arrangement for decomposing water is shown in fig. 1. *x*, is a small glass tube, into each end of which is inserted a cork, having a fine platinum wire passing through the middle of it; the inner ends of the two wires are brought within about one-tenth of an inch of each other, the outer ends are soldered to copper wires, one of which passes into the mercury of the cup *n*, and the other is applied to the cross bar *b*. On turning the machine, gas will be seen to rise from each of the wires.

Attached to fig. 2, is the apparatus for communicating shocks to the tongue. It consists of two small plates of metal, fastened to a wooden handle; to each plate a wire is soldered, one dipping in the mercury of the cup *n*, and the other being applied to the cross bar *b*. On placing the tongue between the two plates, and turning the machine, a rapid succession of shocks is produced. With the machine thus described, the needle of a galvanometer was made to stand steadily at right angles to the magnetic meridian, showing a perfect current."

Two machines, similar to those just described, have been made by Mr. Lukens, one for Prof. Patterson, of the University of Virginia, the other for the University of Pennsylvania.*

* Since the above has been in type, Mr. Lukens has completed several similar machines, improving the mechanical arrangement, by substituting toothed wheels for the wheel and band shown in the figures.

Notes of an Observer.

On Final Causes.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

One of the most remarkable mistakes which can be found in the annals of science, could not have been committed, if the author had been a believer in final causes; for such a belief would have led to the suspicion that something had been overlooked in a calculation which led to the conclusion, that the moon might have been better arranged for the accommodation of man.

The reader will find the passage to which I allude in the second volume of Laplace's System of the World, as translated by Mr. Pond, page 94.

The illustrious author, after a most profound investigation, in which he demonstrates, what had escaped even the penetrating eye of Newton, that the acceleration of the moon's motion is caused by the diminution of the eccentricity of the earth's orbit, steps, as I conceive, out of his way to introduce the following remarkable paragraph.

"Some partisans of final causes have imagined, that the moon was given to the earth to afford it light in the absence of the sun. But in this case, nature would not have attained the end proposed, since we are often deprived at the same time of the light of each of them. To have accomplished this end, it would have been sufficient to have placed the moon at first in opposition to the sun in the plane of the ecliptic, at a distance from the earth equal to one hundredth part of the distance of the earth from the sun, and to have given to the earth, and to the moon, velocities parallel and proportional to their distances from the sun. In this case, the moon being constantly in opposition to the sun, would have described round it an ellipse, similar to that of the earth; these two bodies would thus have succeeded each other above the horizon, and as, at this distance, the moon would not be eclipsed, its light would always replace that of the sun."

Now, it cannot be denied, that there is some point to which if the moon were removed, and projected with a velocity greater than that of the earth, in proportion to its greater distance, as proposed by the author, *if there were no bodies in the universe but the sun, the earth, and the moon*, the result would be, that the moon would go round the sun in the same time as the earth, always rising as the sun sets. But the equilibrium would be like that of a needle balanced on its point, and could not exist a moment, if any fourth body, such as another planet, is supposed to act. Now it can hardly be supposed, that the author meant, that the arrangement here spoken of, might have been made at the expense of having no other bodies in the universe; and yet, without this, the arrangement proposed could not exist.

The reader may easily perceive the truth of this assertion, by considering the effect which either Venus or Mars would have on approaching the moon and earth, under the proposed circumstances.

In the adjacent figure, let v be Venus, e the earth, m the moon,

and *j* Jupiter, or Mars, in their respective orbits, moving round the sun S, from right to left.

Now, it is manifest, that if the moon and earth are so adjusted as to move in their orbits *m*, *n*, *o*, and *e*, *d*, *f*, without the influence of Jupiter, or Venus, when these planets come to act at *j* and *v*, the earth and moon will separate from each other, and the earth will begin to move in a curve within her former orbit, as *e g*, and the moon will begin to move in a curve without her former orbit, as *m p*.

It remains now to show that the equilibrium can never be restored, and that the moon and earth will continue to separate from each other, until they finally perform orbits as independent of each other as of the other planets. This will appear from the single consideration, that the moment they begin to separate, the earth will begin to move faster, and the moon slower, than before, not only because their influence on each other is diminished by their greater distance from each other, but from the universal principle, that all the planets increase in velocity when approaching the sun, and decrease in velocity as they recede from him, and it is manifest that the farther they recede from each other, the less will be their tendency to return. It would not be difficult to calculate the periodical times of the earth and moon in their new orbits; but at present it will be sufficient to make the obvious remark, that the point where they begin to separate will be the aphelion of the earth, and the perihelion of the moon, provided they had been moving in circular orbits before.

This last statement needs no demonstration, to any one at all familiar with the laws of planetary motion.

Indeed, the whole subject is so simple and elementary, that if I could affix any other meaning to the paragraph quoted above, than that which the words naturally convey, I should suppose the author did not mean what he seems to say: for it appears to me almost impossible that so obvious a mistake could have been made by the first mathematician and astronomer of his age. No other meaning, however, occurring to my mind, nor to any of my friends to whom I have shown the passage, I have thought it my duty to notice it to the public, more particularly as it seems to be levelled against final causes, a subject near to my heart.

What is most remarkable in the matter is, that the distance assigned by the illustrious author as that at which the moon should be placed from the earth, is quite too small; for instead of one hundredth, it should be between $\frac{1}{69\cdot2}$ and $\frac{1}{69\cdot3}$, if the quantity of matter in the moon and earth together, is one 332200th part of the quantity of matter in the sun.

Suppose, for the sake of simplifying the calculation, as the result is the same, that one half the matter of the moon and earth is in the earth, and the other half in the moon, so that the centre of gravity of the two bodies may be half way between them.

Now, let the moon be one hundredth of the distance of the sun from the earth, according to the supposition of our author; if it goes round the sun in the same time as the earth, it must fall below a tangent to its orbit one hundredth faster than the earth, that is one 200th faster than a body moving round the sun at the centre of gravity between the moon and the earth.

Therefore, the attraction of the earth for the moon in these circumstances, would have to be one two-hundredth of the attraction of the sun for a body at the centre of gravity between the moon and earth; but calculating its attraction according to the direct ratio of its quantity of matter, and the inverse ratio of the square of the distance, I find the quantity about $3\frac{1}{4}$ times greater, consequently the moon would fall below the tangent to her orbit too fast to remain at the same distance from the earth and sun.

By calculating on similar principles it will be found that the true distance is greater than $\frac{1}{60\cdot3}$, and less than $\frac{1}{60\cdot2}$.

In conclusion, perhaps I may be permitted to say, as an apology for not having pointed out this error when I might have so done, before the death of the illustrious author, that the substance of this paper was communicated to the American Philosophical Society more than ten years ago. It has not, however, appeared in their transactions, and, so far as I know, the error has not been noticed by any other writer.

Should I be wrong, there are a thousand able pens ready to vindicate the accuracy of the illustrious dead.

FRANKLIN INSTITUTE.

Monthly Meeting for Conversation on Mechanical Subjects.

Saxton's revolving keeper magnet,* for producing electrical currents, was explained by Prof. A. D. Bache. The apparatus was made by Lukens, for the University of Pennsylvania. By means of it, a rapid succession of brilliant sparks was obtained, and shocks communicated to the tongue.

Mr. Rufus Tyler, showed the combustion of fine steel turnings in the open air. A portion of the turnings were sufficiently fine to burn rapidly when one part of them was heated by the flame of a candle. The coarser kinds were burned by first exposing them to the flame of the blow-pipe, and then blowing upon them from the lungs, or moving them through the air. The heat evolved in the combustion of the turnings is sufficient to enable them to raise the temperature of the whole to the degree required for combustion. Prof. Bache stated, that Mr. Tyler had, by the heat afforded by steel filings as a fuel, turn over the end of a bar of iron, and welded it completely when turned. The fire was first made by charcoal on a blacksmith's forge, a cylinder placed over the blast pipe from the bellows, and the steel turnings added at intervals.

* See page 155 of the present number of the Journal.

Mr. M. W. Baldwin gave an account of a method which he had employed for renewing files, by covering the projecting parts with a light etching ground, and immersing the file in diluted acid: the cavities are thus attacked, and the prominences increased. The removal of the etching ground, and immersion in an acid, sharpens the teeth thus raised.

A letter from Mr. Thos. Ewbank, of New York, was read, accompanying specimens of different parts of the boilers of the steam-boat New England, which exploded in November last. The specimens were placed upon the table for examination. They were transmitted by Mr. Ewbank to the committee on explosions, to test the relative strengths of the specimens from different situations in the boiler.

P. B. Goddard, M. D., explained the principle of a very simple and efficient stomach pump, invented by him. An account of this, with the cut required for its explanation, will, it is expected, be laid before the readers of the Journal.

REPORT OF THE COMMITTEE ON WEIGHTS AND MEASURES.

Appendix to the Report of the Committee of the Franklin Institute on Weights and Measures.

Report giving an account of the System of Weights and Measures of France. By T. M'Euen, M. D.

The system of weights and measures in France, with the legislation respecting it, has been so ably treated by the late President John Q. Adams, that a reference to his report would fully answer the purpose of the committee. As it was, however, necessary to present to the committee the most important facts connected with this philosophical system, I have endeavoured to do so in a condensed form. A few extracts from the report of Mr. Bonne will serve to show in what confusion the subject was involved before the adoption of the *metrical system.*

The Roman pound, $\frac{2}{3}$ of the Mark pound very nearly, (8oz. Boyer) was in use in France until the age of Charlemagne, who introduced a pound of 12oz. Mark, divided into 20 sous and 240 deniers, which was employed till the reign of Philip I. who fixed the Mark at $\frac{3}{4}$ of the pound of Charlemagne. During feudal times the confusion of weights and measures became great. From that time the evil has been increasing, and efforts have been lately (1790) made to obtain a simple standard.

Monton has proposed the third of a degree of the meridian.

Bouguer, the pendulum vibrating in seconds.

La Condamine, one of its parts.

Pancton, the Egyptian foot which is half a cubit of the Nilometer.

Collignon, the billionth part of a great circle.

The Equatorial foot, obtained from the circumference of the earth at the equator, by observing the movements of the sun, moon, and a

star, is the base of a system offered to the National Assembly by Mr. Bonne in 1790.

This foot.=14 inches Eng. very nearly.

The English foot,= $\frac{6}{7}$ths of an Equatorial ft.=11 in. 3 lines, 2.4 points Paris measure. It is also equal to the foot of Macedonia, those of Urbino and Pesaro, the half arschine of Russia.

The cubit of the Nilometer=1.824ft. English=1ft. 8in. 6lines 5pts. Paris is to the Equat. ft. as 25 to 16, this relation being expressed by complete squares, these two measures will be in the ratio of the lengths of two pendulums which may be easily compared together.

It is divided into 16 digits or 12 inches, of which the ancient Roman foot=10 inches, the Palm now used by the Roman architects =10 digits.

From the measures in use based on this foot as the original standard, some of the most convenient may be chosen; for example, the ell of Bayonne is $2\frac{1}{2}$ft. Equat.

If it were longer it would be inconvenient, as for instance with the Ell of Laval nearly 4ft. Equat. the canne of Toulouse, that of Montauban and of Nozai=5ft. Equat. These measures are so long that a single individual cannot use them with convenience.

Measures of capacity, dry and liquid.—The Equat. ft. being 13in. 1li. $8\frac{5}{7}\frac{5}{1}$ pts. in length, its cube is $2270\frac{24}{25}$ cubic inches. Following the example of the ancients, this is taken for the medimne or minot of grain.

An equal bulk of pure water would weigh $91\frac{3}{45}$lb. mark at $15\frac{1}{4}$ Reaumur, and of wheat would weigh $70\frac{21}{22}$lb.

Pure water is preferable to all other liquids for the purpose of a standard; it is always to be obtained, and is one of the most homogeneous of liquids: besides, it dilates very slightly at the temperature just referred to.

Moreover, the peculiarities of this fluid have been ascertained by very nice experiments, reduced to the mean height of the barometer ($2\frac{10}{29}$ft. Paris), at the level of the sea, in 45 degrees of Latitude, eight times the Equat. ft. would constitute the tun for wine and liquor, it would be the cube of two feet, weighing when filled with pure water $735\frac{2}{3}$ lbs., and containing $378\frac{1}{2}$ pints, Paris measure.

The Equat. cubic foot is also the bushel of water in English measure, and the wiertel of Arnstadt in Thuringia. The mesare of Besançon is one half of this minot; it will be subdivided like the tun, into halves, thirds, quarters, sixths and eighths.

An eighth will be the *quarte*, or quarter, of the bushel; this filled with pure water will weigh $11\frac{45}{91}$ lbs. mark, and with wheat $8\frac{13}{15}$lb.—thus half of the minot for grain will be the bushel, because it is the mean of all the measures of the same kind in France.

The thirds, sixths and twelfths have been proposed, because they correspond with many measures now in use; but if the smaller divisions are by halves, quarters and eighths, the former will be less necessary, as grain is not so valuable as to render very small measures necessary. The Equat. foot will also be the basis of liquid measures:

the mode of deriving the tun from it has been already shown. This foot will be the *metrète* or *amphora*, divided as we have already done the *minot*. The eighth will be the *velte* divided into thirds, sixths, and twelfths.

The eighth of the velte of pure water will weigh $1\frac{4}{5}\frac{1}{5}$lb. mark, this will be the *chopine* of which the double—the pinte will be preferred only because it corresponds with the mean of all the measures of the same denomination throughout the kingdom.

I proceed next to an analysis of the report on the measure of the meridian in France, and the results deduced from it, to determine the basis of the new system of measures, made to the National Institute of France, in the name of the class of Mathematical and Physical Sciences.

In pursuance of a proposition made by Talleyrand to the *Assemblée Constituante*, the Academy of Sciences was directed to decide upon a basis for a system of weights and measures.

The Academy named for this purpose, a committee, consisting of Messrs. Borda, Laplace, Lagrange, Monge and Condorcet; who reported the 19th March, 1791. In this report three methods for obtaining an invariable standard, are discussed.

1st, the length of a *pendulum*, 2nd, a *fourth part* of the *equator* of the earth, 3d. a *fourth part* of a *terrestrial meridian*.

The committee gave preference over other pendulums to that vibrating seconds in lat. 45°.

It must be observed that there enters into computations based on this instrument, a heterogeneous element, which is time, and an arbitrary one, viz: the division of the day into twenty-four hours, or 86400 seconds.

The other two proposed bases are not liable to this objection, as they depend only on linear extension; they have another advantage, which is, that being taken from the surface of the earth, they correspond to the use made of them for the common purposes of life. For instance, the measures of the distance between two points on the earth's surface, or the extent of a certain portion of that surface. It is certainly much more natural to compare the distance between any two places, to a part of a terrestrial circle, than to the length of a pendulum.

The relative advantages of a quarter of a meridian and of the same portion of the equator are now to be examined.

The regularity of the equatorial circle, and the regularity or correspondence of the degrees of the meridian are equally doubtful: but a circle corresponding with the equator is not very susceptible of being measured with accuracy. It may be said with truth that every nation of the earth has its meridian, while but few live at the equator: the operations necessary to determine exactly the equatorial circle, require to be carried on in countries remote from civilization, and the expense and difficulty would surpass the advantage to be derived from them. This would be the case, as well in the first observations, as in those that might become necessary to verify the results obtained. A fourth part of a degree of the meri-

dian is, therefore, to be preferred; a ten millionth part of this extent will be assumed for the ordinary unit of measure.

The customary division of the meridian into degrees, minutes, and seconds, is abandoned, because the decimal division corresponding with an arithmetical scale is more readily applicable to common use, and the inconvenience of two systems of division would be without end.

On the other hand, the difficulty of a change is temporary, and will fall on a few persons, accustomed to calculation: the perfection of the operation should not be sacrificed to considerations, which, in many respects, appear to the committee to be personal.

In adopting these principles, nothing arbitary enters into the measures but the arithmetical scale by which they are divided. And with regard to weights, the choice of a substance homogeneous and at all times easily procured equally pure and dense, to serve as a standard, is the only thing assumed arbitrarily.

To fulfil these conditions we propose distilled water, in vacuo, or reduced to the weight it would have in that situation, and at the temperature at which it passes from the solid to the fluid state.

It is therefore proposed to measure, as soon as practicable, an arc of the meridian from Dunkirk to Barcelona, comprehending a little more than nine and a half degrees. This extent is quite sufficient, and it embraces about six degrees to the north and $3\frac{1}{2}$ to the south of the mean parallel of latitude. To these advantages, is added that of having the two extremities at the level of the sea, points invariably fixed by nature. By extending the line beyond the Pyrenees, all uncertainty as to the influence which these mountains may exercise on the instruments employed, will be avoided.

The operations necessary for this purpose are, 1st, to determine the difference of latitude between Dunkirk and Barcelona, and to make, on this line, all the astronomical observations which may be thought useful.

2nd, To measure the old bases employed in the measure of a degree made at Paris, and in the construction of the map of France.

3d, To verify, by new observations, the series of triangles used in measuring the meridian, and to prolong it to Barcelona.

4th, To make at the forty-fifth degree of north latitude, observations to determine the number of vibrations made in a day, in vacuo, by a simple pendulum, at the level of the sea, and at the temperature of melting ice, the simple pendulum to be equal to the ten millionth part of an arc of the meridian; the number of these vibrations being known, the standard of measure may be formed again at any time by observations of the pendulum. By this plan are combined the advantages of the system adopted, and of those that would arise from assuming the length of the pendulum as the unit of length.

The observations on the pendulum may be made before the ten millionth of the arc is ascertained: as, when the number of vibrations of a pendulum of a given length is known, it will be sufficien for deducing the number sought, to compare the known length of the pendulum to the ten millionth part of the arc.

5th, To ascertain by new and careful experiments, the weight in vacuo of a given bulk of distilled water at the temperature of melting ice.

6th, To compare together the different measures of length, surface or capacity, and the weights used in commerce, in order to find eventually their corresponding values in the new measures and weights, when these shall have been determined.

This report was adopted by the Academy, and presented to the National Assembly; by which body measures were taken for carrying the project into effect.

The Academy was authorized to appoint committees for each of the proposed investigations. This was immediately done; and the selecting and preparing instruments, was the preliminary step taken.

The successful use of the repeating circle of Borda in measuring the distance between Paris and Greenwich, in 1787, the facility with which it is applied to taking altitudes, and its small dimensions, proved that it might be used to replace other larger instruments.

Four were constructed by Lenoir, with a radius somewhat longer than that of the instrument used in 1787 (which was 14 inches.)

The same artist made the platinum rules used in measuring the bases, another platinum rule for observations on the pendulum, and two spheres, one of gold, the other of platinum, for the same purpose.

The rules of platinum for measuring the bases were twice the toise of Peru (i. e. 12 feet French) in length, having a strip of copper on the upper surface to serve as a thermometer, placed upon a support of wood and protected by a roof; there were four of them, numbered one, two, three, and four. When used they were not in contact, but placed near each other, and the distance between them measured by a slip of platinum graduated so as to form a vernier.

The measure of the meridian was made by Messrs. Mechain and Delambre, the latter, that portion between Dunkirk and Rhodez: Mechain, whose operations were between the last named point and Barcelona, was prevented by death from extending the line to the Island of Cubrira, as he had intended. This intention was afterwards carried into effect by Messrs. Biot and Arago.

Two bases, one between Melun and Lieusaint, 6075.90 toises, the other between Vernet and Salies, 6006.25 toises, were measured by Delambre: each about 7 miles.

The latitude of the several points was observed by the same gentlemen.

It is unnecessary to enter into the minute detail of these operations, they were made with the most scrupulous nicety: the results were examined by a number of scientific men of several nations, invited by the French government to constitute a part of the committee on weights and measures. They afford all the data necessary for determining the base of the new metric system; and in addition give rise to some very interesting questions on the form of the earth.

The arc of the meridian between Dunkirk and Montjouy subtends

a celestial arc of $9\frac{6738}{10000}$ degrees; its length is $275{,}792\frac{36}{100}$ modules, about 650 miles. From this base a fourth part of the meridian has been deduced by strict calculations; the flattening of the earth toward the poles being determined from the above measure and others made in different parts of the world, to be $\frac{1}{334}$th of the diameter at the equator.

The fourth part of the terrestrial meridian is found to be 2,565,370 modules; and as a final result, its ten millionth part, or the *metre*, the unit of length is $\frac{256{\cdot}537}{1{\cdot}000{\cdot}000}$ of the module, or 3 ft. 11 lines of the toise of Peru, at 13° Reaumur. equal, according to the Academy, to 39.3827 inches English; according to Capt. Kater, to 39.39079; according to Mr. Hassler, to 39.3802 inches.*

The measures of length are	$\frac{1}{100}$th.	of a metre	or Centimetre.
	$\frac{1}{10}$th.	,,	,, Decimetre.
			,, Metre.
	10 metres	,,	,, Decametre.
	100 ,,	,,	,, Hectometre.
	1000 ,,		,, Kilometre.
	10,000 ,,		,, Myriametre.

The measure of surface is the *are* = 10 metres square; and the *stère* is a solid measure the content of which is a cubic metre.

The determination of the unity of weight was made by Lefevre Gineau and Fabbroni, with equal care and skill.

The points to be decided previously to an experimental inquiry, are; 1st, to fix on the volume to serve as a standard of comparison.

2nd, the choice of a proper substance.

3d, to ascertain the weight, or the quantity of matter, which the substance contains in a given volume.

The volume may be taken arbitrarily, but convenience requires that it should be moderate, and the decimal system that it should be expressed by a cubic number, which is at the same time a decimal submultiple of the metre.

The Academy therefore adopted the thousandth part of the cube of the metre, or, what is the same thing, the cube of the decimetre. They also made choice of water, for the substance of which the weight of a cubic decimetre should be the unit of weight.

This substance, remaining fluid at a temperature easily obta

* As the flattening of the earth's surface towards the pole is not exactly known, the following table shows the difference in length of the metre: when the flattening is,

$\frac{1}{150}$	443.25370
$\frac{1}{200}$	443.24980
$\frac{1}{250}$	443.24854
$\frac{1}{300}$	443.24817
$\frac{1}{310}$	443.24814
$\frac{1}{320}$	443.24812
$\frac{1}{330}$	443.24811
Sphere	443.25171

every where; being of such a density, that accurate experiments may be made in it without difficulty; and above all, being easily obtained in a state of purity, is more appropriate than any other for the purpose in view.

The method which naturally presents itself of determining this weight, that of filling with distilled water a vessel of which the sides are decimetres, and weighing it, offers so little hope of accuracy that it cannot be adopted. Recourse must obviously be had to the principle in Hydrostatics, that the weight of any fluid contained in a given volume, is equal to the weight which that volume loses by immersion in the fluid.

But the experiment in confirmation of the principle which ordinarily appears to be so easy and simple, is singularly difficult, when it is made with a view to determine an absolute quantity; great precision is required, in ascertaining the volume of the body employed, and in weighing it in the air and in the water: reductions are also to be made for the weight and temperature of the air.

To fulfil these conditions, a hollow cylinder of brass, the form most easily made regular, of which the diameter was about equal to the height, and the volume something more than eleven cubic decimetres was constructed. Its sides within, were so sustained that no change of form could take place when it was immersed in water. Notwithstanding the care taken in making this cylinder, it was found to be not quite perfect; it became necessary, therefore, to find its dimensions by the nicest measurement; the exact solid content was 0.0112900054 cubic metre, or 11.29 cubic decimetres.

Weights of brass divided decimally and strictly compared, were used; and the balance employed, was, when loaded with two pounds mark in each dish, sensible to the millionth part of that weight. In weighing the cylinder, it was placed in one of the dishes, and counterbalanced, it was then removed and the weights put into the same dish.

The mean of fifty-three trials, differing in the extremes only by 45 millionth parts, gave as the true weight of the cylinder $11\frac{466}{1000}$ units, and as the counterpoise was of the same substance with the material weighed, the weight in air was exactly what it would have been in vacuo.

In ascertaining the weight in water many other circumstances were to be considered. The mean of thirty-six trials, in which the greatest difference amounted to but 45 millionth parts, gave very nearly $\frac{209}{1000}$ths. of the unit, (exactly 0.2094190) for the apparent weight.

The following allowances were made to obtain the true weight.

1st. The air sustains the weight employed, and not the cylinder which is immersed in water, therefore the weight of a volume of air equal to the bulk of the weights employed, is to be deducted.

2nd. As the cylinder is hollow, the weight of the air contained in the cavity is also to be deducted.

3d. The temperature of melting ice had been assumed for the state of density of the water; it was however found impracticable to re-

duce the temperature below two-tenths of a degree of the centigrade scale; and the mean temperature of the water during the experiments was three tenths.

The experiments of De Luc rendered it probable that the point of greatest density of water was about 5° *centigrade*. New experiments were made to obtain exact results, from which it appeared that the point of greatest density of water is a little above 4° *Cent.* = 39.2° Fahrenheit. A highly important fact, affording a point of density which is invariable, and being the only instance of the kind in a liquid.

The committee determined to employ it, and to deduct $\frac{144}{100000}$ths. of the unit from the apparent weight, this being the difference between the weight lost by the cylinder when weighed in water at $\frac{3}{10}$ths. of a degree *Cent*, and that lost when the water is at its maximum density.

With these allowances the weight of the cylinder in distilled water at its maximum density was $\frac{195}{1000}$ths.

Two other circumstances are to be considered, the weight in air was taken at the temperature of $17\frac{1}{4}°$ that in water at $\frac{3}{10}°$; the contraction of the brass is therefore to be allowed for, according to the result of experiments instituted to ascertain the rate of expansion in brass by increase of temperature.

Again, a small excess of volume arises from the tube of brass by which the cylinder was suspended, these farther reductions bring the true volume to 11.27 cubic decimetres, which is the volume of water weighing 11.27 units.

Whence a cubic decimetre of water at its greatest density weighs $\frac{999}{1000}$ths. of the unit, which is the Kilogramme of the new metric system.

The relation of the arbitrary weight we have called the unit, to the old weights, remains to be considered; for this purpose a comparison was made between it and the "pile de Charlemagne," and it was found that the fifty marks which constitute the pile were equal to 12.227944 units of the weight employed. Its unit was, therefore, equal to 1342.088025 grains mark.

Whence it results that the true Kilogramme or the cubic Decimetre of distilled water at maximum density, weighs, in vacuo, 18827.15 grains mark; or 1644.579 grains English.

The weights are, the	Kilogramme,	divided into	1000 grammes.
	Hectogramme	,,	100 grammes.
	Decagramme	,,	10 grammes.
	Gramme		Unit.
	Decigramme		$\frac{1}{10}$th. gramme.
	Centigramme		$\frac{1}{100}$th. gramme.
	Millegramme		$\frac{1}{1000}$th. gramme.

The measures of capacity are likewise based on the metre, they are, the

Decalitre	=	10 metres.
Hectolitre	=	100 „
Kiliolitre	=	1000 „
Centilitre	=	$\frac{1}{100}$th metre.
Decilitre	=	$\frac{1}{10}$ th „
Litre	=	cubic metre.

The standards prepared by the committee were, for measures of length:

A Platinum metre to be deposited with the Corps Legislatif, to be preserved with the greatest care, and to be used only on the most important occasions.

For ordinary adjustments there were prepared with the same care and precautions, metres of iron, corresponding exactly with each other, and at the temperature of melting ice, with the platinum standard. The ends of these iron metres are preserved from wearing by projections of brass.

As however different metals expand unequally by the same change of temperature, convenience requires that the ordinary standards should be made at 10° or 15° *Cent*; because a change of 10° above or below that temperature will produce a variation of but $\frac{3}{100}$ths. of a millimetre between a metre of iron and one of platinum, and of $\frac{6}{100}$ths. of a millimetre when the metres compared are of brass and iron.

The standards of weight were also a Kilogramme, one of platinum, to be preserved by the Legislature, and several of brass, all exactly equal, to be used as standards for common use.

It is to be observed that the platinum standard when weighed in the air would be heavier than those of brass, by $1\frac{2}{3}$gr. and that this difference, arising from the greater density of the platinum, renders it unfit to be used as an ordinary standard.

Experiments for ascertaining the length of a pendulum vibrating seconds at Paris were made by Messrs. Borda and Cassini; the follows is an outline of their operations.

The experiments were made on the ground floor of the observatory at Paris: the apparatus made use of was attached to a wall of 12 feet high, 8 feet wide, and 2 feet thick. The instruments consisted of a time-piece beating seconds, with which the vibrations of the pendulum were compared; the pendulum fell a little in front of that of the clock, and was suspended from a mass of stone, containing about three cubic feet, placed on the top of the wall.

The weight of the pendulum vibrated at about the height of the bob, and its oscillations were observed through a small telescope at the distance of six feet. The whole apparatus was protected by a case, glazed in front.

The pendulum was supported by a knife edge, and to remedy the weight added to the pendulum, the suspension itself constituted a small pendulum, of which the motions were synchronous with those of the pendulum used for the experiment. So that the centre of

motion may be supposed to be on the plane on which the knife edge moved.

The plane was of hardened steel; to the knife edge was attached an iron wire, which, with the sphere to be described, constituted a pendulum twelve feet long, making a vibration in two seconds: this was preferred to the seconds pendulum, because, as it is four times as long as the last, any error, in measuring the length, would have but one fourth of the effect on the longer one.

The oscillating body was a sphere of platinum of $16\frac{1}{6}$ lines in diameter, weighing 9911 grains, and of the specific gravity of 20.71 at 20° cent.

The wire was attached to the sphere by means of a copper cap, the lower part of which was concave and corresponded with the surface of the sphere.

A thin coating of tallow between the sphere and the cap, produced sufficient adhesion to support the weight; and by these means the sphere could be suspended by different portions of its surface, so as to correct errors arising from unequal density, or want of sphericity.

The length of the pendulum was such that its oscillations were not quite so long as two of those of the clock. The comparison of the pendulums was made when they were both arriving at the vertical, being the time of most rapid motion: a black screen was placed a little in front, the edge of which coincided with the centre of the wire of the pendulums, and with diagonal cross lines on the pendulum-bob of the clock, when they were at rest.

The two pendulums, thus arranged, being set in motion, if the wire disappeared before the cross-lines and the pendulum of the clock made rather more than two oscillations while the pendulum was making one, the interval of time between the disappearance of the two became constantly less; and finally the two objects passed the edge of the screen together. This was the first coincidence. Soon afterwards the oscillations no longer agreed; the clock gaining on the pendulum; after some time another coincidence took place; and the coincidences were observed until the oscillations became so small as to be uncertain.

The oscillations of the pendulum continued for more than twelve hours, but, for the reason above given, the observations were continued but four or five, a length of time amply sufficient to ascertain the relative movements of the pendulum and clock. In fact, when the interval between the coincidences was fifty minutes and the oscillations not too small, the uncertainty, as to the time when the coincidence took place, was not, at most, over thirty seconds, which indicates that the discordance was perceptible when one of the objects arrived at the perpendicular $\frac{1}{50}$th of a second before the other. Whence the duration of the experiment being 4 hours, the rate of the pendulum was determined to the *three hundred and sixty thousandth part.*

The rule used for ascertaining the length of the pendulum was about 12 feet long, of platinum, covered with another of copper of

about 11½ft. long: the two forming a metallic thermometer of which the indications were read on a vernier at the lower part.

At the upper part of the rule of platinum was a cross bar of steel to lie on the horizontal plane, on which the knife edge of the pendulum was placed; the rule was so arranged that when it was in the place of the pendulum its upper end was exactly in the plane of suspension.

At the lower end of the platinum rule, was a slip of the same metal, moving with a little resistance in a rebate, and on this slip were divisions constituting a vernier indicating 200 thousandths of the whole rule.

Another instrument, used in measuring the pendulum, remains to be mentioned. It was a plate of copper placed immediately under the sphere of the pendulum, and attached to a stone projecting from the wall. This plate, which was horizontal, could be elevated and depressed by means of a screw, with a very fine thread.

After an observation with the pendulum was concluded, it was set at rest, and the copper plate carefully elevated till it just touched the lower part of the sphere: the pendulum was then removed, and the rule put in its place. The slip bearing the vernier was then advanced till it touched the copper plate, and thus gave the length of the pendulum from the point of suspension to the lowest part of the sphere. The centre of oscillation of a sphere around a point being $\frac{2}{5}$ths. of the square of the radius divided by the distance of the point of suspension from the centre, its position was known.

Twenty experiments, similar to that described, were made with the greatest care; the results being corrected for the temperature, barometric pressure, varying length of arcs, and in fact, every circumstance that could be supposed to exert any influence: it appears that when each result was compared with the mean result, the greatest difference was but 134 thousandths. Corresponding with one 300th. of a line in the deduced length of the pendulum, vibrating seconds.

Consequently the length of the pendulum, vibrating seconds, in Paris, is equal to 50999.75 parts of the rule, each part being one two-hundred thousandth of the whole rule.

The rule was compared with that numbered (1), used in measuring the bases for the determination of the terrestrial arc. The length of the pendulum was found to be equal to the fraction 0.2549919 of the rule No. 1. at the temperature of melting ice.

By a comparison of this measure with the toise used in former comparisons, it was found that the length of the Pendulum vibrating seconds, is, in lines of that toise=440.5593 lines=0.7418875 metres =29.12166534 English inches; found afterwards by Biot and Arago 0.7419012 metres, or $\frac{14}{1000}$ millimetres less.—The mean being 0.7418943.

Reduced to the level of the ocean, in North lat. 48° 50′ 14″ =0.7419176.

Length of the pendulum at the level of the sea at

Uns	60° 45′ 25″ N. lat.	742.723	Biot.
Fort of Leith	55° 38′ 37″ ,,	742.413	Biot.
Dunkirk	51° 2′ 10″ ,,	742.077	Mathieu, Biot.
Paris	48° 50′ 14″ ,,	741.917	Bouvard, Mathieu, Biot.
Clermont	45° 46 48″ ,,	741.705	Mathieu, Biot.
Bordeaux	44° 50′ 26″ ,,	741.603	Mathieu, Biot.
Figeac	44° 36′ 45″ ,,	741.612	Mathieu, Biot.
Formentera	38° 39′ 56″ ,,	741.252	Arago, Chaix, Biot.

If the earth were elliptic, the length of the simple pendulum would vary as the square of the sine of the latitude.

The difference, or irregularity of the degrees measured is still unexplained. It does not seem to arise from error in the observations, as it is corroborated by the results of different persons, in different places. It is very great, if attributed to local causes. It is still an unsolved problem.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1833.

With Remarks and Exemplifications, by the Editor.

1. For a *Machine for Setting Carriage Springs;* David C. Andrews, Westmoreland, Oneida county, New York, September 6.

This machine consists, in part, of two rollers, fixed horizontally in a frame, like flatting mill rollers; the uppermost moves up and down in slots made in the uprights for that purpose, so that it may advance towards, or recede from, the lower roller. A piece of metal, called a driver, fits over the top of the roller frame in such a way that its two ends bear upon the gudgeons of the upper roller; and a weighted lever crosses the top of the driver, to press this roller downwards with any required degree of force, a second lever being employed to raise this when necessary, acting in the manner of the combined levers commonly used for pressing upon the drill stock in drilling iron at the vice.

When springs of any kind are to be set, such as horizontal, eliptical, cradle, or C springs, the first plate, or leaf, is to be bent into the required form, and cooled; the second leaf, heated, is then to be laid upon this, and the two passed together between the rollers, the lower of which is to be turned backward and forward by means of a crank, after which the other half is to be heated, and treated in the same way. All the leaves of which the spring is to consist, are to be successively set in this manner. A groove is left in the upper roller, to receive the button upon the spring; and there are to be vertical friction rollers on the inside of the frame, to prevent the springs from coming into contact with it.

There is no claim made, and as, so far as we are informed, no similar

machine has ever been used for the purpose of setting springs, the omission may not be a thing of much moment. We see no reason why this instrument should not effectually accomplish the end proposed, and save much labour.

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2. For a machine to be used as a *Blacksmith's Striker;* Lewis Stipe, Stokes county, North Carolina, September 6.

Machines are intended, in general, to lessen human labour, or to transform time into power, so that effects may be produced by ordinary exertion, which it could not otherwise accomplish; we err most completely in judgment, however, if the machine which is the subject of this patent, be found to accomplish either of these objects. The intention is to work a sledge hammer of ten or twelve pounds weight, by means of levers and springs, instead of by the direct application of muscle and nerve to the handle of that instrument.

The hammer handle is to have one end fixed in a roller of eight inches in diameter, and working on gudgeons. The hammer is kept up by means of springs at the back of the machinery, which draw a chain wound round the roller, and it is to be brought down to strike by means of a lever, fixed much in the manner of the common turning lathe treadle, which also operates upon the hammer by the aid of a chain wound round the roller in a direction the reverse of the former. How this lever, or treadle, is to be acted upon, whether by the hand or the foot, is not told us; we suppose, however, that it will require a stout fellow, with two hands, to produce an effect by it much less than that which he might accomplish without the assistance of rollers, levers, chains, or springs.

In the southern states, striking is a lazy business, as the striker never swings his sledge, but uses it in the manner of the small hammer, even in the heaviest work which he performs. Perhaps a machine like that proposed, may answer where there is so little economy of human labour, as is usual in the slave states, and where two common field hands may be taken to vibrate a lever, although they might be unable otherwise to strike more than once in a place. It, however, will never find its way into those districts where it is deemed important that power should be used, and not wasted.

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3. For a *Mill for Grinding Grain, Coffee, &c.;* Jacob Stroub, Charleston, South Carolina, September 6.

This mill is exactly like the common cast iron vertical coffee mill, now so generally used. The manner of making the furrows is represented in the drawing; in this, however, we see nothing peculiar, nor is a word said about it until we come to the claim, which is to "the combination and arrangement of the several parts, but particularly the manner of furrowing the runner and permanent plate."

As to combination and arrangement, there is nothing new, and if any thing of this character exists in the furrowing, we are left in ignorance respecting it.

4. For a *Machine for Hulling Clover Seed;* Hildreth Robbins, Wilton, Kennebeck county, Maine, September 6.

A conical tub is to be lined with sheet iron, punched so as to form a grater, or rubber, and within this, there is to be a conical runner, prepared in a similar manner, by covering it with punched sheet iron. "The invention and improvement of this machine, claimed by the subscriber as his invention, principally consists in said tub and *cylinder.*"

A machine with fewer claims to novelty could not well be *invented* at the present day, as many similar to it may be *discovered* in actual use, and others which are not in use, having been long since worn out in the service.

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5. For a *Metallic Hone and Elastic Razor Strap;* Elisha M. Pomeroy, New Haven, Connecticut, September 6.

In the year 1821, Mr. Pomeroy obtained a patent for a razor strap on which he used the oxide of tin as the sharpening paste; in the present instance, he employs the same material, but makes a difference in the construction of his strap. A piece of wood is to be covered with leather, in the usual way, and then coated with the oxide of tin; this he calls his *metallic hone.* A case made of bonnet board is to be fitted on to this *hone,* so that it will touch its edges, but stand at some small distance from it on its sides. This case is also to be covered with leather and coated on each side with the oxide of tin, but of greater fineness than that on the *hone.* The elasticity of this case is spoken of as constituting the main improvement, and he claims "the principle of its combination, whereby the inconvenience of a hone and strap in separate articles is avoided, by a neat and simple combination of both in a single article: and the principle of elasticity thus obtained, which resembling that of the string of a musical instrument, effectually prevents the rounding of the edge of the razor whilst strapping."

The inner strap above described, whatever good purpose it may answer, cannot be made to possess the attributes of a hone, a main purpose of which is to bring the razor to an edge without *any* rounding, and it must not, therefore, possess *any* elasticity. It is necessary, with a hone, to be able to sharpen a razor by carrying the edge foremost, which cannot be done on a leather strap. Should the use of the hone, however, be less frequently required when this strap is employed, than with others, it would still be no small improvement; those who have used it, speak well of it.

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6. For an improvement in the art of *Dressing Deer Skins;* Orin Kyes, Norwich, Chenango county, New York, September 6.

The successive operations to be performed upon the skins are given in the specification of this patent, but without the slightest intimation of the points in which the novelty of the process consists; and, most assuredly, it is not new in all its parts. The operations are given in six sections, by the first of which the skins are directed to

be soaked in rain water for two days, and then beamed on the flesh side; they are then placed for five or six days more, in a liquor formed by putting a peck of lime and three quarts of strong lye, to a barrel of water;—they are then to be taken out and grained, and put into a sour liquor to neutralize the lime and potash. This acid liquor is formed by the fermentation of wheat bran in water, in the proportion of about half a bushel to a barrel;—after laying in this twenty-four hours, the liquor is to be beamed out of them, and the grained side done over with tanners' oil, milled for an hour, suffered to dry for some time, and then put into strong soap suds for twenty-four hours; when taken thence, they are to be thoroughly dried, scoured clean with lye, dried a short time, and beamed;—the last process consists in soaking them thoroughly in the liquor formed by scouring out the oil with lye, drying, and scouring them with soap-suds, drying again, and finishing them with pummice stone.

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7. For a *Wind Mill Pump;* James Kerr, Maury county, Tennessee, September 6.

This apparatus consists of a wind mill, with half a dozen vanes, by which a horizontal crank shaft is driven, to work the pump rod. After describing the mode of putting together, and connecting the various parts, we are told that "the right of the above combination of mechanical principles, is claimed." There, however, is nothing new in the general plan, or in the particular combination of the parts employed. Water is raised in many places by means of wind mills, and those who wish to employ them may find such as are both simple and effective, without the incumbrance of an exclusive right.

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8. For an improvement in the *Escapement of Clocks;* Orsimus R. Fyler, Bradford, Orange county, Vermont, September 6. (See Specification.)

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9. For a *Dovetailing Machine;* Ari Davis, Lancaster, Worcester county, Massachusetts, September 6.

The essential principle of this machine is said to be "the application of circular saws and cutters to dovetailing, or locking boards through their whole length, and this principle is claimed as being new; not only in the machine described, but the general application of circular saws, or cutters, for the purpose of dovetailing or locking boards breadthwise, as before described."

Circular saws, and conical revolving cutters, are made to revolve on horizontal and vertical shafts, so formed and arranged as to suit the kind of work for which they are to be used. The boards are placed upon carriages, which must also be adapted to the purpose to be accomplished, and for which particular directions cannot be given.

When much work of one particular kind and size is to be executed, a dovetailing and locking machine of the character pointed out, might undoubtedly be used to great advantage, but in other cases, where the machine would have to be set for the particular job, this adjust-

ment would demand more time than would be required for the execution of the work in the common way.

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10. For a *Machine for Pegging, or Nailing, Boots and Shoes;* Asa Woodruff, Westford, Chittenden county, Vermont, September 6.

This machine is for inserting pegs, or nails, singly; it is to be drawn round the edge of the sole, an awl perforating a hole, and a hammer driving a nail or peg in that last perforated, at each stroke. The claim is to "the application of the spring to the pegging awl, and to the hammer, for the purpose of withdrawing the awl from the leather, and elevating the hammer; and also for the purpose of perforating the hole and driving the peg, or nail, by one blow, at the same time, aided by a self-adjusting feeder, and regulated by a cog wheel and gauges, springs, and dogs, to enable the workman to insert every peg, or nail, in a boot, or shoe, equidistant from the edge of the sole, and of equal depth; to prevent breaking or mutilating the pegs, or nails, and to save the greater part of the labour and time required in executing good work by pegging, or nailing, boots, or shoes."

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11. For a *Straw Cutter;* Jonathan Howlet, Greensboro, Guilford county, North Carolina, September 7.

A cylinder eleven inches long, and twenty-two in diameter, is made to revolve on gudgeons, by means of a cog wheel and pinion. Knives extend from end to end of the cylinder, standing off at a proper distance from its periphery, and firmly secured at each end. The straw is to be brought up to the cylinder between feeding rollers, and rests with its ends upon an iron bar, against which the knives cut. The machine is merely described, without any claim being made; therefore, unless it is entirely new in its general construction, which we think is far from being the case, the patentee has secured nothing but the name of a patented machine.

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12. For a *Thrashing Machine;* Jeremiah Fisk, Weld, Oxford county, Maine, September 9.

We have had more breathing time than usual between this and the last thrashing machine, but there has not much of novelty resulted from the respite, as the difference between this and its predecessors is very slight. There are the usual cylinder and concave, both of which are to be covered with sheet iron, punched so as to give to its surface the form of a grater. As it is without beaters, it resembles many of the rubbing machines, excepting in its form, and mode of feeding, which do not differ from most of the patented thrashing machines.

There is no claim made, or any thing pointed out as sustaining the character of novelty.

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13. For a *Screw Auger;* Peregrine Williamson, city of New York, September 9.

The improvement here patented, consists of a plate, or cutter, of

steel, to be fixed on to the end of the common screw auger; which plate can be renewed at pleasure, when worn out or broken. The plate is to be made somewhat in the form of a half moon, adapted in size to the auger, and so shaped as to cut smoothly. It may have a hole for the ordinary centre screw to pass through, and be fixed in its place by one or two screws, according to its size. Upon one edge a lip is to be raised, like that upon a centre bit, to cut the edge of the circle, and make a clean hole. The claim is to the plate so formed and fixed.

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14. For a *Fanning Mill,* for cleaning grain; Nathan Wells, Milford, Pike county, Pennsylvania, September 11.

This fanning mill is made much like those in general use; but the grain is to be carried from the apron, in a direction the reverse of that usually followed. and thrown within one inch of the points of the fans, or wings. The apron, or shoe, at the bottom of the hopper, is to have an up and down motion communicated to it by means of pins on the cog wheel, or its shaft. The hopper is placed at the back of the cylinder, or wind wheel, instead of at top; the patentee says that the advantages resulting from his arrangement, are, the decreased size of the machine; its requiring but about half the timber usually employed; its more rapid execution of the work, and its being afforded at a diminished price; all which, if correct, certainly constitute a real improvement.

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15. For a *Straw Cutter;* Isaac Lewis, Knoxville, Knox county, Tennessee, September 12.

This machine is described very clearly, and there is probably enough of novelty in it upon which to found a claim; but this has not been done, and we are therefore compelled to resort to conjecture, or to drop the inquiry after what is intended to be patented. Several parts which are as distinctly set forth as any others, have been long in use; such, for example, as a feeding trough to contain the straw, and the forcing it forward by a rake or comb, or by feeding rollers. There is to be a cutting knife placed obliquely across a frame, which is worked up and down between fender posts, like the frame of a saw mill. By turning a crank, the necessary gearing is set in motion, which is regulated by a fly wheel. The feeding, as we have indicated, is effected in a well known manner, and the knife is made to rise and fall by means of a crank and pitman; all which appears to be very well arranged.

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16. For an improvement in the *Wheat Fan;* John Deakyne, Petersburg, Dinwiddie county, Virginia, September 13.

The improvement which forms the subject of this patent is clearly set forth, and distinctly claimed. It consists of a cylindrical wire sieve, open at each end like a bolter, and revolving without either arms or axis. This cylinder may be eighteen inches in diameter, and twenty-five inches long; it has on each end a hoop of suffi-

cient strength to enable it to retain its cylindrical form. Above it there are two shafts with whirls on them, over which straps or bands pass, which descend, and embrace the periphery of the cylindrical revolving sieve, near each of its ends.

The improvement claimed, "consists, first, in a revolving sieve, or riddle, having neither arms nor axis. By this improvement, all the interior of the sieve is free from any obstruction to the passage of the straw, chaff, or grain; and as a much greater surface can be obtained by having the sieve of a cylindrical form, more grain can be cleaned in the same period of time with this improvement, than by those constructed upon the common plan, with flat surfaces. Secondly, in suspending the cylinder, or sieve, in bands, and in the manner of gearing it to revolve as above described."

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17. For an improvement in *Water Wheels;* Ebenezer A. Lester, Boston, Suffolk county, Massachusetts, September 13.
(See specification.)

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18. For an improvement in *Nails and Spikes,* denominated the Grooved and Flanched Spike; Thos. W. Harvey, Jamestown, Chataque county, New York, September 14.
(See specification.)

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19. For *Printing Books, &c. by improved machinery;* Harvey Betts, Norwalk, Fairfield county, Connecticut, September 14.

We are informed by the patentee that the general principle of his invention, is the printing of paper in a continuous sheet, on both sides, either directly from the machine on which the paper is made, or from a reel, or roller, upon which it is wound.

We know that the printing press has been actually appended to the cylinder paper mill, by a gentleman in this country, so as to print the sheet as it is made; and we also know that it has been frequently proposed to do so by others; but we are unable to perceive any advantages from such a procedure which would not be more than counterbalanced by its unavoidable inconveniences. Paper has been printed from a sheet of many hundred yards in length, on one side, but we doubt whether this has been advantageously done, on both sides, although it has been attempted, on a cylinder machine. It would be no easy thing in this process to make good register for book work, although it might answer in the newspaper press. Should the present patentee have accomplished this, he will certainly have made another great step in the typographical art. It appears, however, that he has followed the usual, and almost unavoidable course of inventors, in patenting his machine before it has been essayed with that care which is necessary to the establishment of its character. The inventor says, that with the imperfect press by means of which he has experimented, he has seen a length of paper printed in ten seconds, sufficient to make eleven sheets of medium, with paper of only two

feet in width, whilst he has it in contemplation to extend this width to ten, or even *twenty* feet. We have no reason to doubt the goodness of his judgment as a printer, but we cannot say so much of him as a practical mechanist. A cylinder paper machine, and a roller printing press, twenty feet wide, would, we think, appal the great mechanician of Syracuse, had his life been prolonged in vigour to the present day, and his mind imbued with a knowledge of all the wonders which have been effected in the mechanic arts. We like enthusiasm, however, as without it men will almost invariably fall short of what it is in their power to accomplish.

The description given of this apparatus, and the drawing which accompanies it, are both of them crude, being defective in those details which would enable any person to carry the plan into effect; this, we apprehend, has arisen from causes to which we have already made some allusion. Three different processes, and modifications of the machinery, are spoken of as being contemplated by the patentee; he has not, however, made claim to either of them, and the entire novelty of each, in all its parts, may certainly admit of doubt.

It is said that this machine differs from the Napier press in the employing of the whole surface of the cylinder, instead of allowing its intermitted action during the process of inking.

In the first method proposed, stereotype plates are alone to be employed; these are to be firmly attached to a set of blocks, not fewer than six, of the width of a page, and in length equal to that of the paper, "which may be indefinite." The blocks are to be hinged together on their edges, so as to form an endless chain. They are to be carried over a polygonal roller of wood, strong enough to sustain the pressure of the cylinder, by which the impression is made.

In the second process, either stereotype plates or movable types are to be employed upon similar blocks, united by strips of iron in such a way as never to be inverted, so as to allow of the falling out of the types. In the first process, the inking is to be effected below, in the second above, the types, or blocks.

A third method noticed, is the employment of two or more movable forms, passing over a roller, and under a cylinder; the forms after receiving the impression are to descend under the roller, and thence be returned to the position in which they are to receive a new impression.

The modes of inking may be various, but that preferred is by the employment of an endless apron of leather, as wide as the form, and revolving round two rollers about nine inches apart. This is to receive the ink from one roller, and to communicate to another, whence it is to be transferred to the form.

We have thus given an extended account of this patent; and if it be not a clear one its deficiency in this respect does not rest with us, as we have carefully examined the specification and drawing, which ought, in conjunction, to make the plans fully known. We have not resorted to the model, which is referred to in the specification; the reason for omitting this, has been assigned on more than one previous occasion.

20. For a *Swage Hammer*, called the Upright Spring Swage Hammer; William Field, North Providence, Providence county, Rhode Island, September 14.

What is here called a swage hammer, consists of a vertical slide of iron, confined by a suitable frame, or socket, and having, at its lower end, a perforation to receive a die, or swage. Immediately below this is an anvil, which is also furnished with an opening to receive a face, or swage, and a hole to wedge it out when it requires to be removed. Of these hammers and anvils any convenient number may be placed in a line, and a revolving shaft furnished with cams, or lifters, raises the hammers, or slides, and allows them to fall upon the work. To increase the force of the blow, springs are made to bear upon the upper ends of the hammers, and by means of a lever, or treadle, the pressure of these springs may be increased at pleasure. Each hammer is furnished with a catch by which it may be held up when it is to be put out of action.

The patentee claims a patent for "the invention of said machine, and for applying it to the purpose of blacksmithing; for the construction and form of the hammers; for the plan of putting in the faces and dies; for the plan of holding the hammer up when stopped, by a spring and catch; for the manner of connecting the hammers to the main iron plate, or bars, by straps, friction rolls, and bolts; for the manner of giving the blow by the spring and lever connected by an iron rod, at the pleasure of the workman; for the manner of drawing back the catch and setting the hammer in motion; for the manner of wedging out the faces and dies, and for being able to put from four to six hammers into the space generally occupied by one trip hammer."

Perhaps a claim to the particular arrangement of the foregoing machinery, might have been sustained; but in descending to all the particular parts, some of which are probably as old as the time of Vulcan, we are convinced that there are things claimed which are no more patentable than would be the unlocking of the shop door, and the lighting of the forge fire.

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21. For an improvement in *Water Wheels;* Ezekiel M'Guier, and Joel Dewey, jr., Waterford, Saratoga county, New York, September 14.

In this wheel, the water is to descend through a vertical penstock, or trunk, and to pass into a chest, or box, projecting from one side of its lower end and over this the wheel is placed. The top of this chest, or box, is to be perforated with holes, in an oblique direction, to guide the water against the oblique buckets of a wheel, on the bottom of a vertical shaft, which is to be turned by the impulse it thus receives. The top of the shaft is to be loaded, to prevent its lifting by the action of the water.

The wheel, and its appurtenances are very imperfectly described, and inadequately represented in the drawing. So far as we understand it, however, we do not believe that it will be found to be any

improvement upon the common reaction wheel; but, in fact, inferior to it, doing less work with the same quantity of water.

The claims are to "the trunk, or covered spout, running horizontally from the bottom of the penstock to convey the water under the wheel. A valve, or wicket, at the mouth of the horizontal trunk, or spout, where the water enters the penstock. A platform with diagonal holes through which the water propels the wheel. A shaft with circular, or any other floats, or buckets, attached thereto, to apply on said platform. The manner in which the water is applied through diagonal spouts, or holes, in any manner or shape whatever, spouting upwards."

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22. For a mode of *Propelling Saw Mill Carriages;* Joseph Michenor, Chester, Clinton county, Ohio, September 16.

We cannot make our description more brief than the specification, which consists of only four lines of reference to a drawing. The carriage is to rest on friction rollers. A rope, or chain, passing twice round the rag wheel shaft, and attached to the carriage, serves to move it, instead of a wheel and cogs.

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23. For an *Apparatus for Blowing Glass,* denominated an Artificial Glass Blower; Joseph Stouvenel, and Francis A. Martin, Philadelphia, September 16.

A metal tube is to be made which may be sixteen inches long, and one and a half in its interior diameter. This is to be open at one end, and closed at the other; a spiral spring is to fit within it, the coils of which may be half an inch apart, when extended, in which case it occupies the whole length of the tube. A piece of wood, covered with leather, is to form a piston, which may be inserted in the open end of the tube, and fits it air tight, whilst it will slide freely in it. This piston has a hole through it, to receive the mouth end of a blow pipe, which it must surround accurately. By pressing upon the metal tube, when the blow-pipe is so placed, the air within it will be forced through the pipe, with a power, it is said, four or five times as great as can be exercised by the lungs. Articles in open moulds may be blown by the mouth at one operation, which could be accomplished by the mouth in the old way.

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24. For a *Machine for Dressing Staves;* Lemuel Reed, of Madison County, and Alfred Willoughby, Rochester, Monroe county, New York, September 16.

This machine is less perfectly described than it merits to be; as it may undoubtedly be made to dress a stave on both sides in a very perfect manner. Its general structure, however, may be very well understood from the drawing; and we believe it is so far new that it may be defended, although there is no claim.

A wheel turning on an axis, is furnished with knives on its periphery, which are to dress the inside of the stave; a wheel, or hoop, is concentric with, and surrounds the former, at such a distance from

it as is required for the thickness of a stave, and the knives by which it is to be dressed. This hoop is furnished with knives, or cutters, on its inside, and its outside is supported by three friction rollers, running in grooves made on its periphery for that purpose. A strap around the periphery of this hoop, and round a drum on the shaft of the interior wheel, will cause them to revolve, and the stave is to be passed between them by a proper feeding apparatus. It is said that by water, or horse, power, one such machine will dress from twelve to fifteen hundred staves in a day.

There are no details given respecting the cutters, or the feeding apparatus, which is a manifest defect, as it is the duty of every patentee so to describe the thing patented, that a competent workman may be able to make it without the exercise of inventive genius.

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25. For a *Door Lock*. First patented May 18, 1832. Patent surrendered and reissued on an amended specification: James Kyle, Ramapo, Rockland county, New York, September 16.

We gave a full notice of the construction of this lock, in vol. x. p. 341. The patent has been surrendered for the purpose of giving greater precision to the specification, and distinctness to the claims, than was done in the first instance.

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26. For an improvement on the *Door Lock*, for which the preceding patent was obtained; James Kyle, Ramapo, Rockland county, New York, September 16.

We mentioned the lock upon which this is an improvement, in very favourable terms, and those alterations which experience has suggested in it, have certainly rendered it much more perfect. For the lever latches, working upon a fulcrum, and raised by the key, of which we spoke particularly, there have been substituted plates of metal, which slide up and down, and in so doing are acted upon by the cams on the key, without its being necessary to depend upon their own gravity in resuming their places. We have examined one of the locks, which is placed upon a bank door, and have seen few, if any, which are equally simple and secure. As we formerly observed, a drawing would be required to render its construction intelligible.

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27. For *Cutting Horse Shoe and other Nails*, from Bars or Plates of Iron; Edward Rolph, North Providence, Providence county, Rhode Island, September 16.

Grooved rollers, such as are now in use, are to be employed to make ridges crosswise of a bar, or plate, from which nails are to be cut, which ridges, in the process of cutting, are to form the heads of the nails. These are now to be cut with the ordinary machinery, lengthwise of the bar, or plate, so that the grain of the iron will be in the proper direction for the requisite toughness.

"What I claim as my invention, is, the grooving of the ridges on the bars, or plates, for the heads of nails, by the application of the roller,

and the process of cutting the nails lengthwise of the bar, or with the grain of the material."

A patent for a procedure identical with the foregoing, was granted on the 25th of October, 1832, to Freeman Palmer, of Buffaloe, New York, and is noticed at page 233, vol. x.

[TO BE CONTINUED.]

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the Escapement of Clocks or Time Pieces. Granted to ORSIMUS R. FYLER, *Bradford, Orange county, Vermont, September* 6, 1832.

To all whom it may concern, be it known, that I, Orsimus R. Fyler, of Bradford, in the county of Orange and state of Vermont, have invented an improvement in the mode of constructing the escapements of clocks, or time pieces, and that the following is a full and exact description thereof.

Instead of using springs upon the pallets of verges, in the manner described by me in the specification of a patent for improvements in wooden and other clocks, granted to me on the 13th day of June, 1831, I apply a spring to act upon the pin, or arbor, on which the verge vibrates, in a way to be presently described; varying the same so as to adapt it to the particular construction of the pallets; or sometimes I give to the pin itself sufficient length to allow of its operating by its own elasticity, in such a manner as to effect the object which I have in view; my improvement consisting in the practical adoption of a principle, which may be variously modified.

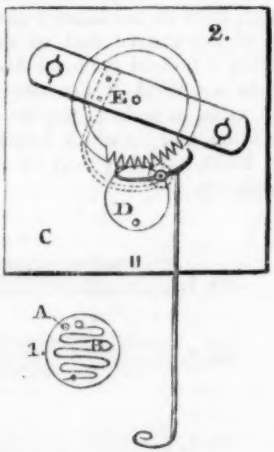
My usual method of attaching a spring to, or causing it to act upon, the pin, is as follows. I take two disks, usually of brass, which may be about an inch in diameter, and a line, more or less, in thickness; through each of these plates, or disks, I make a small hole, near to the periphery thereof, as shown at A, in the accompanying drawing. To one of the disks or plates, I attach a spring, which may consist of wire, coiled, or bent, in a serpentine direction, or made in any other manner. In the drawing, the spring B, is represented as serpentine, attached to the plate by one end; a loop, or eye, in the other embracing the pin upon which the verge socket turns. For a pendulum vibrating half seconds, and with a bob weighing about eight ounces, I have found wire No. 30, to be of a suitable size.

To receive this spring, I make a hole through the front clock plate, nearly as large as the before named disks, one of which is to be attached on each side of the plate, so as to stand parallel to each other, with the holes for the pin coinciding, and a space between them forming a chamber for the spring. I then pass an elastic metallic pin, through the holes in the disks, which must be sufficiently large to allow it to have some play within them. One end of the pin has a swivel head, the other end being fitted to receive the verge socket. Sometimes I enlarge the hole in the outside disk, and support the

outward end of the pin by means of a bridge placed outside of the socket of the verge; care being taken to make the aperture in which the pin rests, something larger than the pin itself. The verge and socket I construct in the way usual in recoil escapements, taking care that all the parts be made as light as can be eligibly done. The verge I usually allow to embrace about one-fifth of the circumference of the balance wheel, escaping in the common manner, taking care to place the pin which supports the verge, as near to the crown or balance wheel, as can be conveniently done, so that the recoil may be increased upon the horizontal pallets, and proportionably diminished upon the vertical section of the verge; the horizontal pallets being most relieved by the action of the spring, as is known to those scientifically acquainted with the subject.

In fig. 2 of the drawing, the verge is represented as placed upon the pin, under the crown or balance wheel.

The advantages of this mode of construction are, that the elasticity of the action of the pin, relieves the recoil, thereby producing a more free and easy motion, and admitting of finer teeth in the crown wheel; all the functions of the escapement will consequently be performed with less motive force, and with less oiling, than is required for common escapements.



What I claim as my invention, and for which I ask a patent, is the principle of giving relief in recoil escapements, by means of an elastic pin, and likewise by coiled, spiral, or other springs, attached in such a manner as to support the pin, and to press it lightly towards the crown wheel.

Fig. 1, represents one of the disks, having a hole in it at A, for the verge pin to pass through, and the bent spring B, fastened at the lower end to a pin, and with a loop at its other end to embrace the verge pin.

In fig. 2, C, is the clock plate, D, one of the disks let into it, and having the spring B on its under side. E, a bridge to remove the pivot of the crown wheel. The dotted line represents a piece of brass, which sustains the pin of the verge at its outer end.

ORSIMUS R. FYLER.

Specification of a patent for an improvement in Nails and Spikes, denominated the Grooved and Flanched Spike. Granted to THOMAS W. HARVEY, *Jamestown, Chataque county, New York, September* 13, 1832.

To all whom it may concern, be it known, that I, Thomas W.

Harvey, of Jamestown, in the county of Chataque, and state of New York, have invented a new manufacture of nails, or spikes, which I denominate *the grooved and flanched spike*, to be used in the fixing of rails and chairs in the construction of rail-roads, and for other purposes, where it is desirable to attach articles by nailing, more firmly than it can be done by nails, or spikes, of the ordinary construction: and I do hereby declare that the following is a full and exact description of the construction of, or form given to, such nails or spikes.

When these spikes are to be used for plate rails on rail-roads, or other similar purposes, the head and neck of the spike, for the thickness of the rail, is made in the usual form, but the remainder of the shank, or stem, of the spike, from the neck to the point, or until the point is approached, is grooved on two sides, in such a way as to leave four projecting flanches, or fillets, thereon, one along each edge. The section of the spike in the grooved part of the stem, will then appear somewhat in the form shown in fig. 3, in the accompanying drawing. Figs. 1 and 2, represent two varieties in the shape given to the lower part of the groove, which, however, may be indefinitely modified, without changing the principle. No. 1, in each figure, shows the grooved, and No. 2, the plain side of the spike, the dotted lines in the latter representing the manner in which the bottom of the groove may be swelled, or serrated, for the purpose of causing it to hold the more firmly in the wood.

I do not think it necesssry to describe any machinery by which such nails, or spikes, may be made; that which I use is of my own invention, and for which I obtained a patent on the 24th day of January, 1832, but they may be made by any adequate implements or machinery.

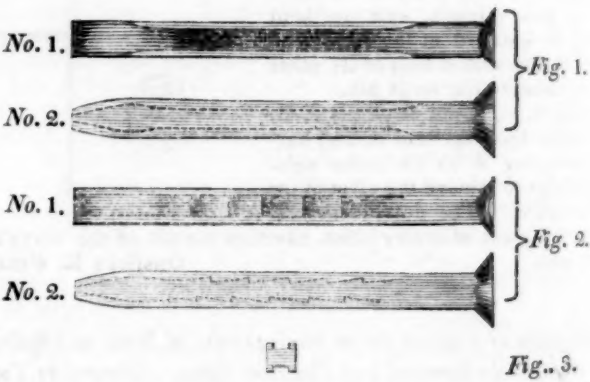


Fig. 3.

What I claim as my invention is, the giving a new form to nails, or spikes, by grooving them on their sides, so as to form flanches, or fillets, on their angles; whether this groove be made of equal depth

throughout its whole length, or whether the bottom thereof be undulating, swelled, or serrated, in the manner herein described, or made of iron, copper, or other metal, or varied in any way which does not essentially change the principle, or manner of construction.

THOMAS W. HARVEY.

Specification of a patent for an improved Water Wheel. Granted to EBENEZER A. LESTER, *Boston, Massachusetts, September* 13,1833.

To all persons whom it may concern, be it known, that I, Ebenezer Avery Lester, of Boston, in the county of Suffolk, in the commonwealth of Massachusetts, in the United States of America, have invented an improvement in water wheels, for the use and application of water, whether acting by projection or gravity, for propelling and operating mills, or any machinery.

In operating said wheel, the water which is to be used as a propelling, or moving power, is to flow or pass from the pond, flume, or reservoir, whencesoever it may be taken, through the hollow shaft of the wheel, which revolves with the wheel, or through a hollow trunk, canal, or inlet of any form, either inclosing the shaft, (which in such cases may be solid,) or connected with the end of the shaft, or with the wheel, engine, or apparatus itself, by means of suitable collars, or hollow joints, or other junctures.

From the shaft, or any suitable part of the wheel, motion may be communicated to the mill, machinery, or body, or weight to be operated or moved, by means of the usual and ordinary gearing, or otherwise.

The said wheel consists of one or more pipes, ducts, or conduits, through which the water is to flow, or pass, and its force, or gravity, to be applied, which pipes, ducts, or conduits, whether one or more, in case the successive parts in their length are at different distances from the axis of motion, pass, by a spiral sweep, from the part of the propelling or acting portion of the wheel nearest to its axis of motion, (but at a greater or less distance from that axis, as the constructor may choose,) to the periphery of the circle of motion of the wheel, in such manner that, if a plane be described through the axis of motion of the said wheel, and through the radius of that axis, passing through the extremities of the pipe, duct, or conduit, nearest to that axis, and such plane be produced, or extended to such periphery, the other, or exterior extremity of the pipe, duct, or conduit, will either be intersected by such plane, or at least will be but a comparatively small proportion of such circle of motion from it. The most perfect construction is deemed by the inventor to be that by which the pipe, duct, or conduit, makes a spiral sweep of an entire circle, so that its two extremities will be intersected by such a plane; but mathematical precision in this respect is not usually attainable in mechanical constructions, and any departure, whether by intention or otherwise, from this plan of construction, to the extent of some comparatively small portion of the circle of motion, is deemed by the

inventor to be within the principle and just extent of his invention, as long as the construction should be substantially equivalent to this plan.

But the said wheel may be so constructed that the successive parts, in length of each pipe, duct, or conduit, through its whole extent, shall be at the same distance, or just about the same distance, from the axis of motion, as if bent, or by being in fact bent spirally round, or within, a cylinder, so that the water, shall be admitted into the pipe, duct, or conduit, either at the upper or higher end of the cylinder, if it stands perpendicularly, or obliquely, or at the most convenient end, if it be placed horizontally. In this case, also, the condition, as to the relative situation or position of the extremities of the pipe, duct, or conduit, will be as above described.

The said wheel, or the base of the figure described by it in its motion, may be horizontal in position, or at any angle to the horizon, or the pipes, ducts, or conduits, where the successive parts, in lengths of each one are at different distances from the axis of motion, may pass off from that axis, so as to make a right, or an oblique, angle with it, and whether they pass off at one or the other, the relative situation of the two extremities of each pipe, in respect to a plane drawn through that axis and a radius to it, will be as above described. If the pipes, ducts, or conduits, pass off at an oblique angle to the axis of motion, each pipe, duct, or conduit, may, in each revolution of the wheel, engine, or apparatus, describe a cone, or hemisphere, or rather a frustum of a cone, or some figure which, as to the curvature of its sides, may be intermediate between them, or between either of them and a cylinder.

The orifice for the admission of water into the pipes, ducts, or conduits, should be so constructed as to admit it very freely.

Thepipes, ducts, or conduits, may be so constructed that a transverse section of one may be square or triangular, circular or elliptical, or of sides of a different curvature, or rectangular, and presenting sides of equal or unequal lengths. It is not necessary, that the pipe, duct, or conduit, should be precisely of the same dimensions throughout its whole length, but it should not, on the other hand, be so irregular that the passage, or current, of the fluid through the pipe, duct, or conduit, shall be disturbed, or irregularly accellerated and checked, and the side especially on which the fluid acts in propelling the wheel, should present to the fluid a very regular, smooth surface, and the pipe, duct, or conduit, should not in any part of its length, be of smaller dimensions than at its orifice of discharge. And the inventor thinks the best construction to be that in which the orifice of discharge is in some degree compressed, and smaller than any other part of the pipe.

The pipe, duct, or conduit, should be so constructed that from one extremity to the other in every successive part in the length, the rate or degree of curvature of the side upon, or against, which the fluid is directed by its motion, that is, the side of the pipe upon which the fluid acts in propelling the wheel, should continually increase or diminish, being greatest at one extremity and least at the other, as if

each successive indefinitely small part of the curve from one extremity to the other, were a part of a circle of greater or smaller diameter than the indefinitely small immediately preceding part of such curve. If the whole length of the pipe, duct, or conduit, be in the same plane, each successive part in its length, from one extremity to the other, will be at a greater distance from, or nearer to, the axis of motion of the wheel, than the immediately preceding part. If the pipe, duct, or conduit, be bent, or curved, as if bent on, or immediately within, the surface, or shell, of a cylinder, cone, or hemisphere, each successive part in the length of the pipe, duct, or conduit, from one extremity to the other, will pass over either a greater or smaller distance (as the case may be) or extent of the axis of the cylinder, or cone, of a radius of the hemisphere drawn perpendicularly to the great circle of the section of its globe, than any equal preceding part in its length.

The pipe, duct, or conduit of a wheel, may be projected on a plain surface by drawing a number of concentric circles, (the more numerous they are, the more accurate will be the projection,) the smallest representing the motion of one end of the pipe in a revolution of the wheel, and the largest, the other end. The space between the smallest and largest circles, will represent the plane, engine, wheel, or apparatus, when constructed. The concentric circles may be at equal distances from each other, or each successive circle in the series may be at a regularly increased or diminished distance from the next preceding, according to the purpose to which the wheel is to be applied, as herein afterwards explained. Radii are then to be drawn from the centre of motion of the proposed wheel, less by one than the number of circles, to the exterior circle, at equal distances from each other. Begin at the intersection of a radius with either the largest or smallest circle, and describe a curve line, passing through the intersection of the next circle, and next radius, and so on through the intersections of each successive radius and circle to the last. This curve will represent a pipe of a plane-wheel, beginning with the intersections of a radius with the smallest circle, and ending with the intersection of the same radius with the largest circle, or vice versa.

It will be evident on inspection, that the curvature towards either end will be increased or diminished, by diminishing or increasing the distances of the successive concentric circle towards that end. This mode of projecting will accordingly afford the projector the means of varying the curvature in the different parts of the pipe at pleasure, as far as it can be varied in a curve beginning and terminating as above described. This is one mode of describing the curve with sufficient accuracy for practical purposes. It may also be described by a movable point regularly sliding on a revolving radius or straight line, and marking the curve, as the radius revolves about a point at which one end is stationary.

The inventor deems the best curvature for the pipe to be such, that if (in case a pipe be such that on being revolved a body may pass in a straight line through it) a particle of fluid, moving with the power proposed to be used, whether that of mere gravity, or that of projec-

tion, and not affected by any other power, should enter at the end of the pipe, and the wheel were turned by a constant motion, so as to make a revolution in the time which the particle would occupy in passing over, or across, the wheel from the circle described by one extremity of the pipe in a revolution of the wheel, to that described by the other extremity, in the direction of a radius to the axis of motion, the particle of fluid would pass through the pipe without touching either side. Such is the general principle in the projection of the pipe, but it is not necessary to the operation of the wheel, to arrive at this result precisely, in its construction. As the momentum and velocity of fluids, whether moving by gravity merely, or by projection merely, or by both combined, are matters of science, concerning which every one may have the means of informing himself, it is unnecessary to mention them in this specification. The preceding directions, with a knowledge of the laws of the motion of fluids, will enable any skilful mechanic to project a plane, wheel, engine, or apparatus.

If the proposed wheel is one in which each pipe in its revolution describes a cone, or frustum of a cone, or hemisphere, or part of a hemisphere, or hemispheriod, or any figure which shall be intermediate between any two of these in degree of curvature of its superfices, or between either of them and a cylinder; it may be first projected on a plane, the smallest circle representing the apex or smallest end of the cone, or the corresponding part of the hemisphere, or hemispheroid, or other such intermediate figure, or portion of either, and the largest circle in the plane of projection representing the base of the cone, or the plane circle of the superfices of the hemisphere, or other intermediate figure, if it have but one plane in its superfices, or if it have more than one, then the largest of them. Let the cone, or other proposed figure, be placed with its base, or its largest plane circle in its superfices, parallel to the horizon. If the plane projection be then placed horizontally over the cone, so that its centre is at the axis of the cone, or if it be placed similarly over the hemisphere, or other proposed figure, then the largest circle of the plane projection will precisely coincide with, and be directly over, the base of the cone, or the lower circle on which such other supposed figure rests. If then a plumb and line be carried round the curve of the plane projection, and, as it is carried round, the plumb be dropped so as to just touch the side of the cone, or other assumed figure, it will describe on its side the curve of the pipe proposed, and any number of pipes for the same wheel may be described in the same manner.

Where the wheel is to be so constructed that each pipe in its revolution shall describe a cylinder, and the whole wheel, if there be a great number of pipes, shall represent a cylinder with the pipes passing spirally round its sides, from one end to the other, the curve of the pipe may be projected on the side of the assumed cylinder by drawing circles round it parallel to its ends, at varying distances, each end being one circle, and drawing straight lines down its sides perpendicular to its ends, less by one in number than the circles, and then describing a curve through the intersections of the successive straight lines and circles, beginning at one end, and passing quite

round the cylinder, and terminating the curve at the other end. The curvature in the different parts will depend upon the proportional distances of the circles, and the degree of curvature to be given to the successive parts is to be determined upon the principles already given.

In projecting the wheel, the assumed figure has been supposed to be in a particular position, but the wheel is not limited to such position in its actual operation.

The foregoing description and directions will be a sufficient guide in projecting the said water wheel, whether the pipe, duct, or conduit, is intended to make a sweep of an entire circle, or only a part of a circle; as a quarter, half, three-quarters, more or less. And though the inventor considers a sweep of an entire circle to be preferable, he does not limit himself to that construction. The mode and principles of projection will be as above described, whether the sweep of the pipe be more or less than an entire circle.

The water may be admitted into all the pipes, ducts, or conduits, (if more than one,) at one and the same time continually, or it may be admitted at intervals into them alternately, or successively, by means of gates, cocks, or valves, or by so placing the wheel, that each orifice of admission may in each revolution be a part of the time above the surface of the water; or the wheel may be so constructed, that the fluid may be shut out from each pipe, duct, or conduit, during a part of each revolution.

The wheel herein described may be made of wood, or of metal, or of both, or of such other materials, and of such diameter and depth, or thickness, and with such number of pipes, ducts, or conduits, as the constructor may choose, having regard to the force to be applied, and other circumstances.

The water may flow, or pass, to the wheel, engine, or apparatus, either horizontally, or from below, or from above, or it may flow, or pass, to the same wheel, engine, or apparatus, both from below or from above, or from both sides, and the same shaft may have one or more wheels attached to it.

The said wheel may be placed in a flume, reservoir, or in the body of water used to propel it, in such manner that the fluid having passed through the pipes, ducts, or conduits, to propel the wheel, may be discharged by means of a hollow shaft, or otherwise.

In case the wheel, is constructed by bending, as if by bending the pipe, duct, or conduit, or each of them, round, or within, a cylinder, spirally, the water will be admitted only at the periphery of the circle described by the motion of the wheel, engine, or cylinder, as the pipes will, in such case, be situated wholly at the periphery.

This invention consists in, and a patent is claimed for, projecting and constructing the pipes, ducts, or conduits, with the curvature, on the plan, and in some of the modes and forms above described for a water wheel.

EBENEZER A. LESTER.

ENGLISH PATENTS.

Specification of the patent granted to WILLIAM RANGER, *Builder, for a Cement or Composition, which he denominates "Ranger's Artificial Stone." Dated June* 4, 1833.

To all to whom these presents shall come, &c. &c. Now know ye, that in compliance with the said proviso, I, the said William Ranger, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the drawing hereunto annexed, and the following description thereof, (that is to say):—

My said cement or composition is intended, as above mentioned, to form blocks, or masses, of artificial stone, to be used in the construction of buildings, in place of brick or stone, or in union with either, or both of them, as occasion may require; and I compose it of silicious or other fit and proper, hard and unchangeable matters, of powdered lime in its pure or caustic state; and of water boiled or heated; and which said water I employ as hot as conveniently may be, in mixing the different ingredients. I likewise occasionally dissolve a portion, more or less, of sulphate of iron in this water, as well also as caseous and other matters, when thought desirable. I prefer to use such stonelime as contains a portion of iron; such, for instance, as that procured in the neighbourhood of Dorking or Reigate, in the county of Surrey; also, graystone lime, lime from blue or yellow lias, or any other lime which is fit and proper for the purpose; and I employ it in the state of a dry powder, not slacked, as usual. The silicious, or other hard materials or matters may be such as are commonly employed; for instance, river or sea sand; screened shingle from the sea shore or beach; the two latter, however, well washed in fresh water to free them from sea salt; or I can employ broken flints, free-stone, copper-slag, or other fit and proper materials of similar natures. Any, or either of these substances, as well as the lime, I separate or reduce into finer or coarser parts, either by hand, or by the employment of machinery similar to that used in making Roman cement, or any other which is fit and proper for the purpose, agreeably to the nature of the artificial stone I design to employ them to form. In general, I prefer to use them in the following proportions, videlicet—silicious or other hard materials or matters, thirty pounds; powdered lime, three pounds; and boiling, or hot water, either containing or not the above matters in solution, one pound twelve ounces. I can, however, vary these proportions occasionally, although I have hitherto found them the best in practice. I avoid mixing more of these materials at once than will be sufficient to fill the mould, as, owing to the heat produced by the boiling or heated water, the setting or concreting action begins immediately that they are put into the mould: and, in general, the mass of artificial stone becomes sufficiently firm in the course of about ten minutes, to admit of the sides and ends of the mould being removed, and the block left upon the bottom of it, ready to be taken to the place where it is to remain to dry and harden, and which will usually happen in the course of a

fortnight, when the block or mass will be fit for use. I cause the materials to be carefully rammed close in all their parts whilst filling the mould with them, in order to expel the air; and remove any excess thereof, by passing a straight iron bar or scraper along the top of the mould; I can then, likewise, when thought desirable, fill any interstices or cavities left in the face of the block, with materials of a finer consistency. The moulds will, of course, vary in their forms and in the manner of framing them, according to the shapes intended to be given to the masses or blocks, of artificial stone; as, for instance, whether they are to be plain or moulded in flutings, or otherwise ornamented or decorated; or whether to be square, circular, or of any other shape; so that it is quite impossible to afford examples thereof to any extent. As, however, it may be desirable to give some idea of their construction, I shall proceed to do so by describing the several figures contained in the drawing, which, as aforesaid, is annexed to this specification, and which represents the various parts of a wooden mould, intended to form plane oblong blocks of artificial stone, each part being designated by a similar letter of reference in all the figures.

Fig. 1.

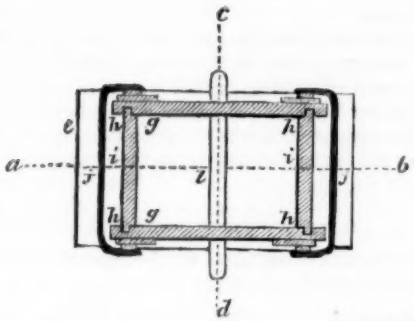


Fig. 2.

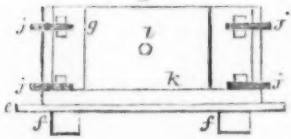


Fig. 3.

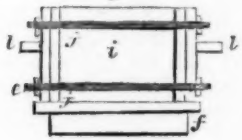


Fig. 4.

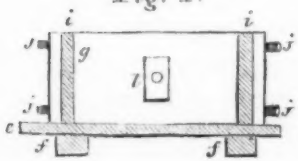
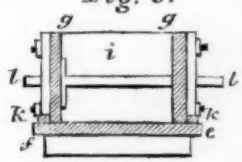


Fig. 5.



e, is the bottom of the mould, resting upon and strengthened by the two cross pieces *f f*. *g g*, are the sides of the mould, each having two upright grooves formed in it, as shown at *h h h h*, in the plan fig. 1, to receive and retain the ends, *i i*, of the mould in their proper situations. These sides and ends are held together by means of four iron bars, *j j j j*, whose ends are bent at a right angle, so as to form clamps, as shown in fig. 1, between the inner ends of which said clamps and the sides of the mould, wooden wedges may be tightly driven, to hold the mould together in use, and be as easily removed again when it is to be taken asunder. There are also two wooden ledges, *k k*, affixed upon the bottom of the mould, as shown in the end section, fig. 5, to retain the sides and ends of it steadily in their places upon it when in use.

Fig. 2 is a side elevation; and fig. 3 an end elevation of the mould; and fig. 4 is a side elevation and section of it, taken at the dotted line *a b* in fig. 1.

Fig. 5 being an end elevation and section taken at the dotted line *c d* in fig. 1. *l*, in all the figures, is a bar passed through holes made in the sides of the mould, to form a hole through the block of artificial stone. I prefer to place the blocks, or masses, of my artificial stone in the open air to harden, and even to wet them occasionally during that operation.

I do not mean, or intend hereby, to claim as my invention, the use of hot water in mixing mortar for building with; but I do hereby claim the employment of boiling or hot water in combination with dry, powdered, caustic lime, and silicious or other hard matters, in the manner and in the proportions herein before described, as my invention, and as essential to the forming of my said blocks, or masses, of artificial stone. [*Rep. Pat. Inv.*

Patent granted to ALEXANDER CLARK, *for certain improvements in Blowing Machines. Dated January* 15, 1833.

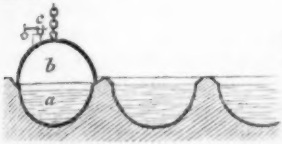
This invention consists of an arrangement of apparatus having a revolving fan, such as is used in many blowing machines now in use; and the chief object at present in view appears to be, the production of a portable machine, to be used as a substitute for the common bellows. To the end of a nosle similar to those used for bellows, is affixed a shallow cylindrical box, which contains a circular disk, mounted on an axis which turns in bearings at each end, in the covers of the cylindrical box. On to the disk, and at the outer edge thereof, vanes are affixed at right angles, and at one end of the cylindrical box, an opening is cut for the admission of air; and on to the axis which carries the revolving fan is a small wheel, which is kept, (by means of a spring,) in contact with a large wheel which has its axis affixed on the nosle piece.

The manner of using this machine is as follows:—It is held in the left hand, and by means of a handle affixed on the large wheel, this wheel is caused to revolve, and by the friction of its periphery, the small wheel is made to revolve rapidly, and drive the air through the

nosle. In order to prevent noise or rattling of the parts, the patentee recommends that the large or driving wheel should be covered with buff leather. [*Ibid.*

¶ *To* ABRAHAM GARNETT, *Esq. for his having invented certain improvements in Manufacturing Sugar. Sealed July* 7, 1830.

The particulars of this improved mode of preparing sugar are not very clearly described in the specification. It appears that the object of the patentee is to promote the crystallization or concentration of the sugar by the employment of an apparatus, in which a partial vacuum is produced above the sirop in the pan, or *teach*, as it is called.



The annexed figure is a sectional representation of a series of pans or boilers, in which the cane juice is placed for the purpose of boiling and evaporating; *a*, is the last pan of the series called the teach, into which the sirop is to be poured by a ladle from the pan preceding it. The upper edge of the teach has an inclined flanch, upon which the edge of the hemispherical cover *b* shuts down with an air tight joint. This cover may be raised and lowered by a chain and pulley, by means of a lever, or otherwise; and a safety valve *c*, is placed in the upper part of the hemisphere to allow of the escape of steam when the sirop is boiling.

According to the statement of the patentee, the heat of the boiling sirop will cause the atmospheric air to be expelled from the dome or hemispherical cover, and by that means produce a partial vacuum within. Under this partial vacuum, the evaporation from the sirop will go on with a rapidity very much greater than if the surface was exposed to the atmosphere, and the steam evolved will escape through the valve *c*, at top, thereby leaving the dome vessel in a constant state of exhaustion.

As the evaporation goes on from time to time, fresh supplies of the sirop are to be introduced from the adjoining pan, in which case the dome is to be raised a few inches only while the sirop is poured in, and then the pan is to be closed again air tight, the steam thrown off by the boiling of the sirop escaping at the safety valve.

When the sirop has acquired a sufficient degree of concentration, it may be discharged into the ordinary cooler, and, after remaining there for twelve hours, may be placed in boxes having wire gauze bottoms, to allow of the molasses draining through; and, after six days, may be packed as Muscovado sugar, and sent to market.

There is an observation at the close of the specification, that if the sugar is to be clarified by Innes' patent process, it may be drawn out of the *teach* from time to time; and upon every thickness of about three inches of sirop, a slight shower of lime water is to be let fall for the purpose of cooling it. What patent process is referred to we

know not, as no patent has been granted in that name for refining sugar within the last thirty years. [*Lond. Jour.*

¶ *Specification of the patent granted to* WILLIAM AINSWORTH JUMP, *for certain improvements in drawing or extracting Salt from Salt Pans. Dated October* 14, 1831.

In making or manufacturing salt, it is the practice of the salt waller, or boiler, to draw the salt from the pan by raking it to the sides, and then removing the salt by means of a skimmer or perforated shovel. This operation of raking the salt to the sides of the pan is not continually performed, but only from time to time when the salt is to be removed from the pan; consequently, the salt, as it crystallizes, falls to the bottom of the pan, and tends to prevent the heat from the furnaces or fires coming directly to act on the brine, such heat having first to pass through the layer of salt on the bottom of the pan; by which, not only is much of the heat lost, but, at the same time, the action of the heat on the metal, causes there to form what is called "pan-scratch," or "pan-scale," on the upper surface of the pan, and then the continuation of the action of the heat quickly destroys the metal. Now my invention is the continually raking of the salt towards the sides of the pan, and into pockets or recesses formed to receive it; thereby, in some degree, preventing the formation of pan-scratch, or pan-scale. But the principal object of such invention, is, the being able to extract the salt from a pan covered, so as to preserve the steam produced from the brine, for the purpose of heating other salt pans. And I perform this operation by means of an arrangement of apparatus or machinery hereafter described; and which arrangement of apparatus constitutes my invention, and consists of revolving rakes set at an angle, whereby the salt is continually raked towards the sides of the pan, till it falls into recesses formed to receive it.

Description of the Drawing.

Fig. 1. *Fig.* 2. *Fig.* 3.

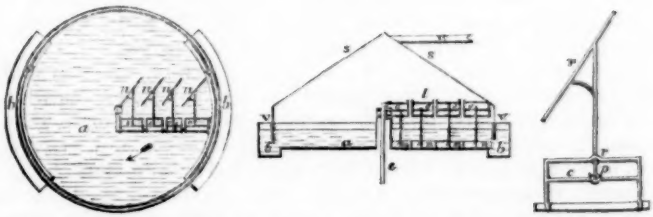


Fig. 1 represents the plan of a circular salt pan, having two recesses formed to receive the salt; or there may be formed a recess all round for the same purpose: from these recesses the salt is to be removed by hand, as heretofore. Fig. 2 is a section of fig. 1, taken through the centre. Fig. 3, is an enlarged view of a scraper and

its frame; and in each of these figures the same letters of reference indicate similar parts; *a a*, being the pan and *b b*, the pockets or recesses to receive the salt as it is raked from the centre of the pan to the sides thereof. The pan *a a*, is set in brickwork, having a furnace or furnaces, as is usual. I will here observe, that I do not confine myself to the use of a naked fire for the purpose of heating the brine in the pan *a a*, but intend to avail myself of other well known means of heating the same, such, for instance, as steam. But as my invention only relates to the means of raking the salt towards the sides of the pan, for the purpose of drawing or extracting the same therefrom, I do not conceive it necessary to be more particular in describing the means of heating the brine, they being well understood. *e*, is an upright shaft, to which motion is imparted by any of the well known mechanical means. On the upper part of the shaft *e*, there is an arm placed, *l*. This arm *l*, carries the scrapers *n n n n*, the handles of which scrapers are affixed in the swinging frames *o o o o*, in the following manner: On the handles of the rakes *n n n n* there are formed hooks *p p p p*, which hook into holes formed into the swinging frames *o o o o*, as shown in the drawing fig. 3. In order, however, to keep the rakes to the intended position, the handles pass through eyes *r r r r*, also formed in the swinging frames *o o o*. By this means, the rakes, by their own weight, keep to the bottom of the pan, and have the property of accommodating themselves, in a certain degree, to the warping, or deviation from level, which generally takes place in the bottoms of salt pans after being some time in use; and as they are caused to revolve by the slow turning of the shaft *e*, they continue to rake the salt from the centre of the pan towards the sides thereof: that rake which is farthest from the centre, drives off the salt which lies in its track, towards the sides of the pan, and forces it into the recesses; the second scraper succeeding the first, rakes the salt towards the sides of the pan into the track of the first, and the third scraper succeeding the second rakes the salt into the track of the second, and so on; and thus is the bottom of the pan continually cleared from salt, and the heat comes immediately to act on the brine. I have described, and have shown, only four rakes; but I would have it understood, that more, or less, may be used, without departing from my invention. The shaft *e*, is protected from the action of the fire by a wall of brickwork. *s*, shows the cover of the pan inserted in the water-lute-joint v, and to be suspended by a counterpoise, so as to be easily raised and lowered for the purpose of scumming or clarifying the brine, changing the scrapers when clogged with salt, or any other necessary purpose. w, the pipe conveying the steam under another salt-pan.

Having now described the nature of my invention, and the manner in which the same is to be performed, I would have it understood, that I claim as my invention, an arrangement of revolving rakes in salt pans, such rakes being set at an angle to a line drawn through the centre of the pan, whereby their revolving will continue to rake the salt outwards from the centre to the sides of the pan, in the manner above described. *Rep. Pat. Inv.*

¶ *To* JOSIAH JOHN GUST, *Esq., for an improvement in the process used for producing from iron ore and other materials containing iron, what is called in the iron trade "finers."* *Sealed January* 31, 1833.

The claim of this patent is for an improved manufacture of what is termed 'finer's metal,' immediately from the blast furnace, instead of casting it into pigs, and allowing it to cool as usual, in the manufacture of iron from ore, or other substances containing iron. The patentee states, that he places his refinery as near to the blast furnace as possible; and the top of the refinery must be under the level of the tap hole of the blast furnace, from whence an iron shute or channel protrudes; and on the furnace being tapped, the fluid iron will flow immediately into the refinery, to be converted into finer's metal, instead of being cast into pigs, and allowed to cool as heretofore.

[*Lond. Jour.*

¶ *On Boring Cylinders.*

The following brief accounts of the progress made in boring cylinders,—so important a feature in that branch of mechanical operation which relates to steam enginery,—we have extracted from that most admirably written, and comprehensive work, "Historical and Descriptive Anecdotes of Steam Engines, and of their Inventors and Improvers, by Robert Stuart:" a work from which the dilettante in mechanical invention will draw a large fund of sound information; while the "Operative" himself will have at his command a compendious body of reference to every valuable improvement that has been achieved in his branch of science, viz. the application of a power, which, next to that of the printing press, stands forth as the loftiest promontory in the chart of human invention.

"The increasing demand for the ponderous machinery of steam engines, having led capitalists to the erection of numerous founderies in different parts of the kingdom, their emulation was greatly instrumental in improving the art of casting and finishing cast iron ware. Carron, the first establishment in regard to magnitude, continued also to be the most celebrated for the general excellence of its productions; and it more especially enjoyed a great reputation for the truth with which its cylinders and pump barrels were bored and polished. The method usually followed was that employed from time immemorial for boring the wooden pipes or pump trees used to convey water. The pipe, placed in a carriage, was made to move forward as accurately as could be, in the direction of its axis, and to press against the face of the borer; this was a tool constructed of several cutters firmly fixed in a solid wheel, which was made to revolve by the power of horses or a waterfall; and as the cutter excavated the centre of the pipe, the frame moved forward so as to keep the tree pressed against the tool.

"But notwithstanding the proportions and modifications which

Smeaton introduced into the boring engine he designed for Carron, and which gave the superiority to the cylinders and pump barrels fabricated in this foundry, over those sent from rival establishments, still the form of the cylinder, when drawn from the mould, influenced more or less that which it could receive from the action of the borer.

"Much of the advantage which now began to be experienced by engineers, from a greater attention paid to the mode of finishing pipes and cylinders, would have, in truth, been greatly circumscribed in their importance, but for an invention of Mr. John Wilkinson, the proprietor of iron works at Bersham, near Chester. In this beautiful contrivance, provided there was a sufficient thickness of metal, the want of truth in the casting of a hollow vessel was quite immaterial; for Wilkinson made his borer advance into the cylinder *along an inflexible rod*, which was fashioned with the greatest possible truth. So that the tool must excavate in a line as true as that which was formed by the rod which guided it; and this, without question, was one of the most important improvements which had been introduced into the machinery for the manufacture of machines. Indeed, so universal was its application, that it may be considered as forming an era in their manufacture, as having laid the foundation of all the wonders which have since been achieved, in giving the utmost accuracy and beauty to implements and machines of every kind, and of every variety of construction.

"But in nothing was its importance more clearly seen, than in the fabrication of the parts of steam engines. Cylinders of five and six feet in diameter, and piston rods of corresponding sizes, could be formed by its agency with the greatest truth, and as much precision as, before its introduction, it was possible to give to the small cylinders of air pumps.

"Watt speedily availed himself of his friend's improvement; and by having his rods and pumps properly bored and polished, he may be said now, for the first time, to have had it in his power to give comparative perfection to his own invention. For even the excellent workmanship of the Carron cylinders was so much surpassed by those made at Bersham, that when a new engine, on the condensing principle, was to be erected at Carron itself, Bolton writes to the chief of the establishment, that he must either change his mode of boring cylinders, or get one bored by Wilkinson, 'for he has,' says he, 'lately bored us some nearly without error; one which we have put up at Tipton, fifty inches in diameter, does not err the thickness of an old shilling in any part;' and in a letter from Watt to Smeaton, he says, 'so great has been the improvement made by Wilkinson, that he can promise upon a cylinder having a diameter of seventy-two inches, not being further distant from absolute truth in the worst part than a *thin* sixpence.' But even this deviation (about the fortieth of an inch) was greater than could be found in these ponderous vessels; for, from the admirable nature of the process, it was next to impossible that so great an error could be produced in a vessel, of however large dimensions."—*Stuart on Steam Engines.*

[*Rep. Pat. Inv.*

¶ *Report of the result of an Experimental Journey upon the Mail Coach Line of the Holyhead Road, in Lieutenant Colonel Sir* CHARLES DANCE'S *Steam Carriage, on the first of November* 1833.

Public attention having been attracted to the practicability of travelling with locomotive engines upon ordinary turnpike roads, by a report of a committee of the House of Commons, of the 12th of October 1831, stating that, in the opinion of the committee, the practicability of such mode of travelling has been fully established; and more recently by a report of a journey to and from Brighton having been successfully performed by Lieutenant-colonel Sir Charles Dance's steam carriage, as well as by the fact that the same carriage was daily in use between London and Greenwich, conveying numerous passengers through the crowded suburbs of the metropolis without the slightest inconvenience to the public, we were desirous of personally making an experiment of the facility with which a carriage of that description could perform a journey of considerable length; and having selected the mail coach line of the Holyhead road for the purpose of such experiment, we made an arrangement with Sir Charles Dance for the use of his carriage, on Friday the 1st inst.

The weight of the carriage, with the water, coke, and three persons upon it, was about . .	3 tons,	5 cwt.
The weight of the omnibus coach attached to it	1 "	0 "
The weight of the passengers, their luggage, and some additional sacks of coke, about .	1 "	15 "
Making the gross weight moved . . .	6 tons,	0 cwt.

The motive power was an engine with two cylinders, seven inches in diameter and sixteen inches stroke. The pressure of steam on the tubes constituting the boiler, or generator, was not allowed to exceed 100 lbs. per square inch.*

Before the carriage had proceeded six miles, one of the tubes of which Sir Charles Dance's boiler is composed, was found to leak so fast as to render repair absolutely necessary; it was also apparent that the size of the engine was not sufficient to carry so great a weight along a heavy road at any high velocity.

The weather was by no means favourable, there having been much rain in the course of the night and morning, so as to make the road heavy, added to which the winter coating of new materials had, in many places, been laid upon the road. Notwithstanding these obstacles, upon our arrival at Stony Stratford, fifty-two and a half miles from town, it was found by Messrs. Macneill and Carpmael, who had taken accurate minutes of the loss of time occasioned by stoppages, that the average rate of travelling had been seven miles per hour.

* These facts have been ascertained by Mr. Joshua Field, Mr. John Macneill, and Mr. Alexander Gordon, civil engineers.

Thus there can be no doubt, that with a well constructed engine of greater power, a steam carriage conveyance between London and Birmingham at a velocity unattainable by horses, and limited only by safety, might be maintained; and it is our conviction that such a project might be undertaken with great advantage to the public, more particularly if, as might obviously be the case, without interfering with the general use of the road, a portion of it were to be prepared, and kept in a state most suitable for travelling in locomotive steam carriages.

Thomas Telford, President of the Society of Civil Engineers.
John Rickman, Secretary and Commissioner of Highland Roads and Bridges.
C. W. Pasley, Lieut. Col. Commanding the Royal Engineers, Chatham.
Bryan Donkin, Civil Engineer.
Timothy Bramah, Civil Engineer.
John Thomas, Civil Engineer.
Joshua Field, Civil Engineer.
John Macneill, Engineer to the Holyhead Roads.
Alexander Gordon, Civil Engineer.
Wm. Carpmael, Civil Engineer.
J. Simpson, Engineer to the Chelsea Water Works.
London November, 1833.

¶ *On the extensive Atmosphere of Mars. In a letter to his Royal Highness, the* Duke of Sussex, *K. G., President of the Royal Society.* By Sir James South, F. R. S. Read before the Royal Society, December 13, 1832.

Through the kindness of your Royal Highness, I had some time since the honour of calling the attention of astronomers to the "Extensive Atmosphere of Mars"—to the observations of those great men from which its existence was inferred,—and I showed that they were either unsupported by, or were at variance with, my own. Still, however, as the observations, of which mine seemed subversive, were bequeathed us by astronomers, to whom astronomy owes deep and lasting obligations, respect due to their memory, demanded that I should rather enforce the necessity of further observations, than treat the matter as actually decided.

This night has put me in possession of fresh evidence, and I lose no time in forwarding it to your Royal Highness, in the hope that it may have the honour (should you, as President of the Royal Society, think it worthy) of being presented by you for insertion in those journals, which contain so rich a mine of astronomical truths.

During twilight, in the field of the large equatorial, I saw a star of the eighth or seventh magnitude, south preceding the planet Mars; its place (approximately taken with the five feet equatorial) was right ascension, 3 hrs. 29 min. 19 sec., and its northern declination about

20° 22′; as additional identification, it was found to precede a star of the seventh or sixth magnitude, about five minutes, twenty-six seconds and five-tenths, and was about one minute and forty-eight seconds of a degree south of it. These preliminaries settled, the night became cloudy; but at about three hours and a half siderial time, the sky being clear, on directing the instrument to Mars, the planet was seen somewhat more than half a minute from the star. The star, as previously noticed, was of a light blue colour, affording a pleasing contrast with that of the planet, and was tolerably steady; the planet's limb was extremely unsteady. The object glass of the large Equatorial is 11.85 inches in its clear aperture, and has nearly nineteen feet focus. It has two finders, the one a telescope of 4.40 inches aperture, and five feet focal length; the other 2.75 inches diameter, and forty-two inches focus. They are placed parallel with the tube of the large object glass, so that the same siderial object presents itself in the centre of the fields of the three telescopes at the same moment. The object glasses of all the three are very perfect; and taking them in the order of their diameters, beginning with the largest, they were supplied with the powers of 520, 250, and 120; and that the observations might not be vitiated by the unsteadiness of the polar axis, cylinders of wood were placed east and west of the large telescope, so that towards their upper extremities, they rested against that telescope's tube, whilst their lower ends were on the observatory floor. The five feet equatorial also was placed upon the planet with a power of 133 only. With this instrument, the star was seen by one observer, till the planet's limb had reached it; with the large finder of the large equatorial, another observer saw it, till a small segment of its disk had been cut off by the planet's limb; whilst with the small one it was distinguishable when not more than three seconds of a degree distant from it. But although the planet's approach to the star was observed with the several telescopes, it is to the large equatorial only that we must refer, with the reasonable hope of detecting any minute optical change which the star might apparently undergo.

No such phenomenon, however, occurred, for the star retained its light blue colour and comparative steadiness till the very instant of its occultation, which took place at 4 hrs. 32 min. 24.7 sec.; nor did its splendour suffer any diminution prior to disappearance, except what may fairly be attributed to the light of the planet. I saw not the slightest projection of the star upon the planet's disk.

Again, at the emersion, which happened at 4 hrs. 50 min. 41.7 sec. the star, with the large equatorial telescope, was seen neatly dichotomized; with the large finder it was detected before the planets disk had separated from it; by the five feet equatorial, when it was still clinging to it; and by the small finder when it was not more than three seconds distant. With the large telescope it was watched with the greatest attention, at, and for some time subsequent to, the emersion; and I feel confident, that not any thing remarkable occurred, any more than at, and previously to, the emersion. The planet had passed his opposition nine days.

Reflecting on these facts, and on those I have before presented to

your Royal Highness, I can arrive at no other conclusion than that either some physical change has occurred in the "extensive atmosphere of Mars," or that the accuracy of the observations of Cassini and of Roëmer, must be regarded as untenable.

November 29, 1832. [*Trans. of Royal Society.*

¶ *Magnetic Experiments on Chronometers.*

From the Nautical Magazine, No. xv.

Many of our readers will persue with much interest the following account of some experiments communicated by Messrs. Arnold and Dent on the subject of magnetism affecting the balances of chronometers. That magnetism does influence the chronometer has long been supposed, and, in order to obviate its effects, other metals, instead of steel, have been used in the construction of the balance and its spring; but the subject has not hitherto received that attention which its importance demands, and we know of only one series of experiments besides the following, to have been made, with the view of ascertaining to what extent the magnetic force is capable of deranging the performance of this machine. It has been generally admitted by seamen, that a chronometer changes its rate after its removal on board, and preserves what may be designated a sea rate. The subject appears to have been totally neglected before the year 1820, when a paper "On the Errors in Longitude, as determined by Chronometers at Sea, arising from the Action of the Iron in the Ships upon the Chronometers," was drawn up by Mr. George Fisher,* and communicated to the Royal Society in the month of June in that year, by John Barrow, Esq. We will here give the abstract of the paper to which we have alluded:

"The sudden alterations in the rates of chronometers, when taken on board ships, are generally ascribed to the motion of the vessel; but from circumstances connected with the chronometers of the Dorothea and Trent, during the late voyage to the North Pole, the author is induced to refer these alterations to other causes: he found that in all cases the gaining rates were increased, and their losing ones diminished, on ship board. That this accelleration does not arise from the ship's motion, was shown by its occurrence when the Dorothea and Trent were beset with ice, and when they were at anchor close in shore, without any perceptible motion; nor does it appear that change of temperature was at any time the cause of this change of rates. That the iron in ships becomes magnetic is shown by its polarity, the whole forming, as it were a large magnet, having its south pole on deck and its north pole below. The inner rim of the balance of chronometers, which is made of steel, will therefore be liable to magnetic action, which will be sufficient to cause a very sensible alteration in their rate of going.

Mr. Fisher concludes this communication with some account of

* The present Chaplain of H. M. S. Victory

experiments on the action of magnets upon chronometers placed in various positions, with respect to their balances, by which it appears that an accelleration in these cases always ensues. It also appears probable, he observes, that the force of the balance spring is affected by the same cause, since chronometers in which they are made of gold, though more difficult to adjust, keep better rates at sea than others.

"An appendix, containing tables of rates furnished by Mr. Coleman, is annexed to this paper."

Both series of experiments completely corroborate each other, and prove to the seaman the secret and prolific causes of derangement to the good performance of his chronometer, causes which must be ever varying their effects, and which must depend on the situation of the ship, and the direction of her head. In the high latitude in which Mr. Fisher's experiments were made, the deranging effects proceeded from the iron of the ship, independent of the magnetic effects of the earth, which latter must increase and contribute its deranging effect likewise in lower latitudes. To have discovered the means of removing these difficulties by the exclusion of metal entirely from the balance spring, and making other alterations in the balance, which Messrs. Arnold and Dent have effected, must be considered as the greatest improvement which the chronometer has received since it was invented,—an improvement which will contribute to the protection of life and property, and the advancement of geography.

To the Editor of the Nautical Magazine.

84, Strand, 11th April, 1833.

Sir,—We are enabled at length to perform our promise of furnishing you with a detailed account of our Chronometrical experiments with the magnet, that have been made at the Royal Observatory at Greenwich during the last few weeks, and to which you alluded in your Magazine for February last. The remarks which were then made on the subject of our chronometers, were designed chiefly to explain that we had taken upon ourselves to examine "de novo," the entire theory of those valuable machines, with a view not only to simplify the construction of that most important member, the balance, which neither theory nor practice have as yet been able to rescue from the complication of difficulties which result from its present state; but also, as a necessary consequence to our success in this particular, to lessen the great price which has hitherto been demanded for chronometers, and thus to remove a principal obstacle to their more general employment in the Royal Navy. As far as we had then proceeded, our wishes had been fully realized by our having actually produced a very material reduction in them of one-third of their former price, and as many of your readers will be anxious to learn the cause of such an alteration, we venture to offer you the following explanation of it, and to enter more fully into the improvements which we have lately introduced in the balance and other parts of the chronometer.

The principal feature of our last experiments consisted in the trial of a balance of an entirely new construction, in several chronometers, the rates of which were recorded in your 12th number. This balance was constructed by Mr. Arnold some years since; in fact, the first trial made of its merits was with chronometer No. 521, the rates of which were particularly mentioned by you in your paper before alluded to. The balance constructed on the old principle was considered by Mr. Arnold to be defective in many respects. One or two of its most obvious objections may be more plainly shown, by referring to the annexed figures, which represent the two forms in which the balance is at present made.

Fig. 1.

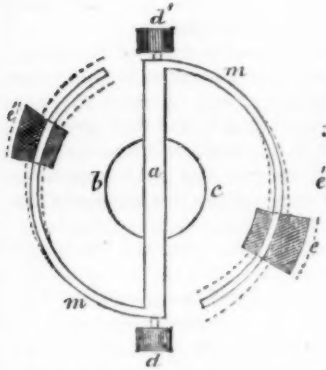
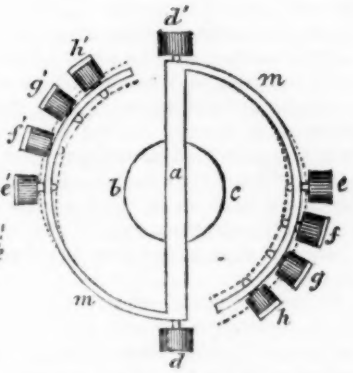


Fig. 2.



In both figures, the letter *a* distinguishes the arm of the balance, *composed of steel.*

Through the centre of these arms pass the verges or axes, round which, as is seen in the figures, are coiled the balance springs *b*, *c*. The lamina of brass and steel for the compensation are shown at *m*. the inner circle being of steel and the outer one of brass. In fig. 1, *d* and *d'* represent respectively the timing screws for the six and twelve hours; the sliding weights *e* and *e'* are for the compensation. Now, if any alteration be requisite for the timing of the positions, &c., it is effected by reducing a small portion from these weights, a process which is necessarily attended with much inconvenience, as the balance must be entirely removed from the chronometer before such alteration can be made; and, moreover, the compensation for temperature is thereby disturbed.

Fig. 2 differs from the former, in the screws *e* and *e'* being entirely used for correcting the vibrations on mean time in the different positions, while the screws *f*, *g*, and *h*, and *f'*, *g*, and *h*, are used solely for temperature. The process of compensation in this balance is more simple and convenient than in fig. 1. A number of small holes being made in the lamina, the several screws are moved so as

to form greater or less angles as the adjustments for temperature may require. In both figures the balances are represented as at the time when the perfect adjustments for compensation, &c., have been applied; the broken lines in each show the variation of figure, the interior being that which they assume in heat, and the exterior that in cold, when under any great extreme of temperature. This deviation in the balance from the true figure of a circle may disturb its centre of gravity, as the lamina of the balance, their screws and weight evidently contract and expand unequally to and from the centre. Moreover, the balance is thus powerfully influenced by centrifugal force.

The explanation of our patent balance we must leave for a future opportunity, the subject being of so much importance that we should necessarily occupy more of your attention than would be reasonable. We will merely state that the objections which we have here pointed out, are entirely removed by this new balance.

Your readers will be able to judge from the rates of the chronometers in your 10th number, how far this alteration in the balance is worthy to be considered as an improvement. It must not be forgotten, that inquiry has but now commenced, and that perfection, or any approximation thereto, must be the work of time.

We will now proceed to lay before you the final experiments which we have made, with a view to ascertain the magnetic influence on the chronometers.

Several reasons suggested themselves, to render this question important.

In the first place, we have repeatedly found that a very considerable change takes place in the rate of our chronometers, on removing them from our house to the Royal Observatory for trial. We do not mean to quibble about two or three tenths of a second, because the removal of them from one place to another might have a tendency to produce for a time errors of this magnitude. But we now allude to one or two seconds deviation in rates, which it must be allowed are tangible quantities. Now, in the carriage of a chronometer from London to Greenwich, by some horizontal motion accidentally given, a discrepancy of one or two seconds in the *actual error* of the chronometer may be produced; but by experiments it is found that any casual accellerations in the vibration of the balance produce no permanent injury to the rate when the equilibrium is restored. We have known many instances (and we are not singular in our observation) where, assuming the mean rate of a chronometer in the Strand to be 3s,0 per diem, the removal to Greenwich has produced an immediate and constant rate of 4s. or 5s. per diem. The same may be said of the removal of chronometers from Greenwich to the Strand.

We are of course founding our remarks on observations made on the very best of our chronometers, where anomalies of this nature are too striking to be disregarded.

We are enabled from the public documents of the Royal Observatory relating to chronometers, to produce two or three instances of

effects of this nature, to which we refer, having taken place on the removal of the chronometer from Greenwich to other places. We give the mean weekly rates before and after removal of three chronometers by various makers:—

— 4s,5	— 0s,9	— 4s,5	At the Royal Observatory.
5 ,1	1 ,1	4 ,2	
4 ,4	0 ,9	3 ,9	
4 ,1	1 ,4	4 ,1	
— 1 ,4	+ 2 ,6	— 6 ,1	Elsewhere, immediately after removal.
1 ,4	2 ,8	6 ,6	
0 ,9	3 ,0	7 ,5	
0 ,9	3 ,1		

But we will carry this subject still further. What we have above stated will, doubtless, by some be objected to on the score of the possibility of derangement from carriage from one place to another. We will now state a fact which cannot be opposed by the same argument.

Let a chronometer be so placed that the six hours of the dial be turned towards the north point of the horizon, and the twelve hours towards the south, so that a line drawn from six to twelve is in the line of the magnetic meridian of the place; hence a line drawn through the nine and three hours will pass through the east and west parts of the horizon respectively. Now, if the chronometer be rigidly kept in this position for some days unmoved, which, by a little contrivance, may be easily affected, a mean rate may be obtained; and if the chronometer be then turned in azimuth 180°, so that the twelve hours and six hours point, respectively, to the opposite points to which they did before—the three and nine hours to the east and west, respectively—the mean rate derived from it in this position will vary materially from the former rate. Again, if we obtain a mean rate from the chronometer when the twelve and six hours point, respectively, to the east and west, a third result will be obtained, differing from the two former so as to become a mean between them: and, lastly, by reversing the positions again in azimuth as we did the north and south, we shall have a result quite analogous to the last.

We do not, however, pretend to assert that the change in the rate of the chronometer is so extensive, or so discernible from these latter experiments, as in the case of a removal of the machine from Greenwich to London; the circumstances are very different, and a different result is produced.

But the most remarkable effect attending the removal of the chronometer is that produced on going from the maker to the ship. It is also the most important one, because if magnetism really produces an effect on the rate of a chronometer, its proximity to large masses of iron, &c. being unavoidable on board a ship; the evil is then more severely felt, when not only natural magnetism operates, but its most

potent auxiliaries, in the shape of the iron work on board, &c., present so powerful an artificial magnet.

The polarity that exists in the iron which is to be found in every part of a ship is to be descried by the constant deviation of the north end of the compass when placed on deck, towards the centre of the ship.

A remarkable instance of the effect produced by the removal of a chronometer to a ship, occurred in the case of one of our chronometers, Dent No. 114, which, having established its fame at the Royal Observatory by gaining the first prize in the year 1829, was shortly after removed to His Majesty's ship Blossom, commanded by Captain R. Owen: no sooner was it on board, than it immediately altered its rate from 3s,96 to 5s,0 per diem, and preserved it with great satisfaction to all parties.

The foregoing are the principal reasons which induced us to refer the greater part of the evils which now affect the balance of a chronometer, to the effect of magnetism. The balance, according to its present construction, as we have before stated, is mostly composed of steel. The arm *is one solid mass of steel*, and a tolerably thick circle of the same metal forms the inner part of the lamina for the compensation. The balance spring is also entirely formed of steel, so that, on the whole, a considerable quantity of this metal is introduced into a chronometer. The first experiment we made to investigate our theory of the magnetic influence on it, consisted in removing a balance from one of our old chronometers, which had shown symptoms of fluctuation of rate in different positions, and suspending it by a very fine fibre of sufficient length, that the force of tension might be destroyed, at the same time taking special care to guard it from any current of air which might convey to it a rotatory motion, by covering it with a glass frame.

This experiment was gratifying in the extreme, and at once confirmed our opinion of the existence of a *polarity* in the balance. We afterwards suspended several balances in the same manner, and in every instance, the results were entirely as we had anticipated. The balance, in fact, performed in every respect the functions of a magnetic needle, one end of it assuming the character of the north pole, the other that of the south. The application of an artificial magnet, caused effects quite analogous to those which would have been produced with the needle.

We must here make a necessary digression from our subject, for the purpose of endeavouring to account for the phenomena of a polarity having been induced in the balance. The natural attraction of masses of steel and iron is one of those secrets of nature which no philosophy has yet been able to penetrate, and the mystery is equally as great in the case of the polarisation of metals. But, although we cannot explain the cause of these natural facts, we know from experience that the effects are very easily produced by artificial means.

Thus, if a bar of steel, hard, tempered, and apparently unmagnetized, be held in a position forming a slight angle with the vertical, so as to coincide nearly with the axis of the earth, and while in this

position it shall receive several blows from a hammer, it will have acquired all the properties of a magnetic needle. Now, in the mechanism of the arm of the balance, the very force which the artist employs in polishing it, together with the friction which it undergoes in working, may have a direct tendency to induce a polarity, so that there can be but little doubt that before the balance comes out of the hands of the workman, the evil is already accomplished.

To return now to our last mentioned experiment. Having quite satisfied ourselves of the existence of a polarity in the balance, we next endeavoured to ascertain the relative magnetic influence exerted on different balances, constructed apparently on like principles, and of like dimensions. We accordingly set two balances oscillating at an angle of thirty-five degrees from the magnetic meridian, and when this angle had decreased to thirty degrees, the time occupied in each ten successive vibrations were accurately registered till the angle had decreased to ten degrees. We found, however, but little difference in the comparative effects produced by magnetism on them; but, as might be expected, the smaller the arm of the balance was, the more conspicuously was the magnetic force exerted, and the fewer the vibrations requisite to restore it to its natural position.

Our whole attention was now turned to devise a method by which the evils that manifested themselves so clearly might be obviated. The entire removal of all magnetical susbtances in the construction of the chronometer became indispensable, but the task was far more difficult than can at first be conceived. In the spring, for instance, the substitution of gold for steel is natural enough, but the danger of doing so is very great.

We have already discussed this subject in your last number, to which we beg to refer your readers.

It may, however, be proper to add, that the discovery of the use of glass for a spring, which we there noticed, did not take place till after the experiments which we are now explaining were nearly completed. We could not, therefore connect the trial of the glass spring with those experiments. The springs we have used in the experimental chronometers in which we wished to avoid steel, have been made of gold, with an alloy of copper and silver, and to all appearances, we have succeeded in making such a compound of these metals that the frangibility of the spring is very much reduced. A great deal yet remains to be done in this respect, although we have every confidence in the final success of our glass spring, which will supersede the use of metals altogether.

Some little difficulty attended the alteration requisite to be made in the balance. The arm of our patent balance is composed of platinum and silver, and the two perpendicular screws are of brass, as well as the weights and timing screws.

Our first wish was to suspend this new balance in the same mode as we had done the old one, and the result of the experiment was highly satisfactory. In the first place, it assumed no fixed position as the former one had done, but stood suspended in any horizontal position in which it was placed. The interference of the magnet did not in-

dicate the existence of any attraction between it and the balance, although at times we were disposed to alter our opinion on this point. We do not, however, for a moment doubt the susceptibility of all metallic bodies to become magnetic. In fact, from experiments which we have made, connected, though indirectly, with the present subject, we are quite convinced that every metal may be said to possess a certain degree of inherent magnetism.

In a future part of this paper, we shall produce important evidence of the truth of this theory, at all events, as regards brass, platinum, and silver.

[TO BE CONTINUED.]

Observations on the Circumstances producing Ignition in Charcoal, in Atmospheric Temperatures. By Mr. WILLIAM HADFIELD.*

The spontaneous combustion of charcoal under certain circumstances has been long observed, though it has not excited the attention which it merits; nor would it now, perhaps, have possessed much general interest, had it not been for the serious consequences which may result from its occurrence in some situations. As large quantities of charcoal are used in gunpowder manufactories and in other works, its spontaneous combustion in many places would manifestly endanger, not only much property, but a number of lives. The subject is therefore worthy of attention, since, if the cause could be assigned, the danger might be averted.

Engaged during twenty-five years in a manufactory where charcoal is produced, I have had many opportunities of observing the phenomenon; and I have been induced, by the suggestions of a number of my friends, to lay the amount of my own experience before this Society.

Though I am aware that a very interesting article on this subject was, in January last, published by Col. Aubert in the "Bulletin des Sciences Militaires," I shall abstain from any further notice of it, since I wish to confine my present paper to the result of my own observation and experiments.

If twenty or thirty hundred weig tof charcoal, in a state of minute division, be put together in a heap, and remain undisturbed, spontaneous combustion generally ensues. The fact has been long known, but no investigation, with the exception of that to which I have referred, has, to my knowledge, been instituted.

Spontaneous combustion does not often take place in what the manufacturers call *round charcoal;* that is to say, in fragments of considerable size; unless when large quantities are laid together, under which circumstances it is not very unusual. In this case, the phenomenon is generally ascribed by the makers to the charcoal not having been sufficiently cooled after its production. This reason is,

* Read before a meeting of the Literary and Philosophical Society of Manchester, on November 4, 1831; and now communicated by the author.

no doubt, sometimes, but not always, correct. On the contrary, I have known charcoal, which has been freely exposed to the atmosphere for several days, enter into a state of ignition, when, though closely watched, it presented in the interval no appearance of the kind.

In one case, charcoal was loaded in Manchester, and conveyed by a cart to the distance of twenty miles. No combustion appeared during the loading, nor could the carter, though he carefully examined, perceive any indication of it, when, at eleven o'clock, he left it for the night. At five o'clock on the following morning, however, he was called up to save his cart, which he found on fire, and nearly consumed.

This charcoal had been made three days before the accident. Care had been taken that it should be sufficiently cool before it was loaded, as a similar event had previously occurred to the same parties, who ascribed it to the charcoal being too new, when, as they conceived, fire lurked in it unextinguished.

These two instances may, I should think, be accounted for in the following manner:—

When large quantities of charcoal, as in the first example, are laid together, it is evident that the lower parts must be exposed to pressure, and, by the motion of the cart, to friction from the parts above; in this way, therefore, a portion of the charcoal is pulverized, forming a compact mass at the bottom, where it enters into spontaneous combustion.

In the second instance, pressure and friction had still greater influence. The carter, while he was loading, beat down the charcoal with a large hammer, to force it into a smaller compass. Conveyed for twenty miles in a cart, the pieces would rub against each other, and the finer parts would be shaken to a compact mass; and possibly the friction might in this case particularly, produce a degree of heat which would promote the ignition.

Before I proceed to an account of my own direct experiments, I will describe here another instance of spontaneous combustion which occurred casually. About 2000 lbs. weight of charcoal were loaded at Cornbrook, in the cart of Messrs. Williamson & Co., powder-manufacturers of Fernelee, near Buxton. The charcoal had been made several days before, and had lain freely exposed to the open air. No indications of combustion could be perceived. After being taken out of the cart at Fernelee, it was left for the night, and the next day finely pulverized, as a preparation for making gunpowder. It was then thrown into a heap; and no appearance of a tendency to ignite ensued. This was on the Saturday evening; and on Sunday, the building which contained it was observed to be on fire. The fire must have commenced with the charcoal, as every other source of heat was carefully excluded, on account of the gunpowder manufactory.

These, and a number of other accidents which have arisen from the same cause, united with the opportunities which I have possessed

as a manufacturer of charcoal, have led me to take particular interest in the subject.

Colonel Aubert's paper, which I have already alluded to, and an abridged translation of which appeared in Dr. Brewster's Journal for April last, 1831, placed the subject in so striking a point of view, that I came to the determination of making, for my own satisfaction, a few experiments, which I shall proceed to describe.

Exp't. 1.—120 pounds of charcoal, slightly pulverized, were put into a flour barrel, and a leaden tube, of an inch and a half in diameter, and fourteen inches long, inserted in the middle, to hold a thermometer. The temperature of the charcoal when put into the barrel was sixty degrees. In two days the charcoal acquired a temperature of seventy degrees; from that time the temperature gradually diminished until, in two days more, it was reduced again to sixty degrees, —the temperature of the surrounding atmosphere. This charcoal was rather old, having been made several weeks, and afterwards freely exposed to the open air.

Exp't. 2.—120 pounds of fresh charcoal, pulverized as before, were put into the vessel used in the preceding experiment. The charcoal was then at 70°, and the surrounding air at 62°. In twenty-four hours it had acquired a temperature of 90°; in thirty-six hours, of 110°; and in forty-eight hours more it was down to 70°, as at the commencement.

Exp't. 3.—The same quantity of charcoal was taken as in the foregoing experiments: it was quite fresh, and ground into coarse powder. In thirty-six hours the temperature was 130°; it then gradually declined to 70°, when the experiment was given up.

From the preceding experiments I was satisfied that spontaneous combustion would not take place in so small a quantity. I therefore determined to make the experiment upon a larger scale.

Exp't. 4.—10 cwt. of new charcoal was finely ground, and put into a hogshead, with a thermometer placed, as before, in a leaden pipe. Several holes were bored in the sides of the hogshead to admit the air. The charcoal, when ground, was 65°; and particular care was taken in examining the charcoal, to see that it was free from ignition. It was put into the hogshead at about ten o'clock in the morning, and at night, its temperature had risen to 90°; the following morning, to 150°; and in the afternoon of the second day, the thermometer stood at 180°.

I was surprised to find at this time that combustion had taken place at about five or six inches from the surface, and about the same distance from the leaden pipe which contained the thermometer, though the temperature, as indicated by the thermometer, was only 180° or 190°.

It may perhaps be proper to remark, that the combustion always takes place *near* to the surface; or, if small charcoal be laid against a wall, the combustion generally begins either at the surface, or close to the wall.

On the 13th of October, 1831, small charcoal was thrown into a heap, which covered about ten feet square, was about four feet deep,

and contained from two to three tons in weight. In three days the temperatare had increased to 90°, though it was at first only 57°, being the same as that of the air. On the 19th, it was 150°, and on the 20th, combustion had occurred in several places. Water was thrown upon it, and the combustion was, to all appearance, effectually extinguished; yet, on the 21st, it was again observed to be burning in different parts; and it continued to burn until it was removed and formed into smaller heaps.

The last experiment was the most satisfactory one which has ever come under my notice. The charcoal had been made for at least ten or twelve days before it was put together; and had been lying, during the interval, in small heaps freely exposed in the open air.

I am not aware that any experiment has been made to ascertain the effect of the exposure of the charcoal to pure oxygen gas. A bell glass, of the capacity of two quarts, was filled with oxygen gas previously freed from carbonic acid by washing with lime water. In this vessel was placed a glass dish, containing an ounce of finely pulverized charcoal. The charcoal was left to stand in the oxygen for twenty-four hours, and at the expiration of that time, no trace of carbonic acid was to be found on passing the remaining gas through lime water.

This experiment was three times performed in the same manner, and with precisely the same result.

I have here given a brief and simple statement of the observations and experiments which I have yet made upon this curious and interesting subject. The spontaneous combustion of charcoal is, I apprehend, now fully established: and I have endeavoured, to the best of my ability, to determine some of the circumstances under which it takes place. I have abstained from any theoretical speculations; contented, for the present, to have related the facts which experiments alone have elicited. If in future any new facts should present themselves, I shall be happy to submit them to the Society.

[*Phil. Mag.*

Pressure of the Ocean.

In those accustomed to the Greenland whale fishery, the immense pressure of the ocean cannot but have excited much astonishment and curiosity. In the common method of capturing whales, it is customary to strike them, at first, by a harpoon, an instrument well known to the sailors, with a stock or handle of fir, ash, or hickory, with a line of a very considerable length attached to it; and as soon as struck, the whale generally descends, nearly as quick as a bird, to a very great depth, taking the harpoon along with him, buried to the depth of twelve or eighteen inches in his body, while the other end of the line is particularly coiled in the boat, and veered out by the harpooner with much caution and dexterity. It sometimes happens that the whole of the first boat's line, though no less than 1080 fathoms long, will be taken under water in a very few minutes; and

if another boat be not near for the harpooner to fasten the end of another line to the end of his own, the whale must be suffered either to go away with the line, or else with both boat and line; the latter method can only be taken when a convenient piece of ice is at hand for the preservation of the boat's crew. And it has too frequently happened, that the line has got entangled in the boat, in consequence of which the whale has taken it completely under water along with her, and given the whole, or most, of the crew, a watery grave. During my career, I have twice experienced this misfortune, having had the boat taken twice from under my feet; and at another time a whale cut my boat completely in two with his tail. During the absence of the whale under the water, many boats are collected around, waiting his return to the surface, when he is immediately struck by another, or perhaps two harpoons, and then descends again the same as before, put probably not a tenth part so far as at first, ere he is obliged to return again to the surface to breathe. He is then struck with lances, instruments with a blade and shank from four to six feet long, which are thrust to the same distance into his body, and which makes the blood spout out in torrents. One or two good lances, directed to proper parts of the body, speedily put an end to his existence, when he immediately turns on his back, and lies flat on the surface of the water,

It had long occurred to me, that when the harpoons were taken out of the new killed whales, they were much heavier than usual; and that they were obliged to be hung up in the galley, (the place for cooking,) before a large fire for several days, before they could, at any rate, be made use of again; nor were they, after this long exposure to heat, near so light and handy as at first. This had frequently attracted my notice, without any further investigation of its cause, until the year 1820, on board the ship Harmony, of Whitby, when, after capturing a whale in the usual manner, I observed a harpoon stock, which was broken close to the socket, and which I believe was of fir, drop into the water, and immediately sink like a stone. This excited my curiosity afresh, and I determined to examine more minutely the several harpoon stocks which had been taken down by whales to similar depths; and on cutting then in two with a saw, I found that of whatever kind of wood they were made, they were as completely soaked in every pore, to the very heart, as if they had lain at the bottom of the sea since the creation of all things! and even some of them were cracked and fissured in different places. Besides, their surfaces were invariably covered with small air bubbles, like froth, for a considerable time after they had risen above the surface of the sea.

I also corked and sealed an empty quart bottle, and sent it down with the marine diver to the depth of 100 fathoms; and when drawn up, the cork was found in the inside of the bottle. I then made another cork, rather too large for the bottle, knocked it in with a mallet as far as I could for fear of breaking the bottle, which, being sent down to the depth of 100 fathoms, was found to be pushed in; and it is very probable that had the cork been sufficient to resist the pres-

sure, the bottle would have been crushed to atoms. However surprising this may appear, all astonishment must necessarily vanish when we consider the immense pressure which must of necessity take place on every part of the surface of a body immersed under such a vast column of water: such a pressure as no vacuities, however strongly protected, can resist.

The pressure on the bottle, consisting of only 85.215 square inches of surface, at the depth of 100 fathoms, is found by calculation to be no less than 10 tons, 9 cwt. 1 qr. 13 lbs., and that on the cork 15 stone, 6 lb. 2 oz. And at the depth of 900 fathoms, or 5400 feet, the pressure on every square foot of surface, will be $5400 + 34 \times 1000$ oz.$= 5434000$ oz.$= 151$ tons, 12 cwt. 1 qr. 13 lb.

THOS. BEVERLY.

[*Nautical Magazine.*

¶ *Influence of Colours on the Absorption of Heat, and of Odorous Principles.*

On the 20th of June, 1833, a paper was read before the Royal Society, "On the influence of Colour on Heat and Odours;" by James Stark, M. D. of Edinburgh, of which the following is an abstract—

The author observes, that the only experiments on record relating to the modifying effect of different colours on the absorption of heat from solar light, are those of Franklin and Sir H. Davy. In order to investigate this subject, the author employed pieces of wood, silk, and cotton, which were wrapped round the bulb of a thermometer placed in a glass tube; the tube was then plunged into boiling water, and the time which elapsed during the rise of the thermometer from one given point to another, was accurately noted. Other experiments were also made with an air thermometer, of which the bulb was coated with various coloured materials, and heat thrown on the ball by means of polished tin reflectors from an Argand burner. The results accord very nearly with those of Franklin and of Davy, the absorbing power with regard to different colours, being nearly uniformly in the order of black, brown, green, red, yellow, and white. The author next investigates the differences which occur in the radiation of heat by differently coloured substances, a subject on which he is not aware that any experiments have ever been made previously to his own. The mode of ascertaining the amount of radiation was generally the converse of that by which the absorption of heat had been determined; namely, by exposing the coloured substances, in contact with a thermometer, to cooling instead of heating processes. The general result of all his experiments was, that the loss of caloric by radiation follows exactly the same order, with regard to the colour of the radiating surface, as its absorption. In the second part of this paper, the author gives an account of a course of experiments which he made with a view to discover the influence of colour on the absorption of odorous effluvia, and more especially in the case of the

absorption of the fumes of camphor and assafœtida by woollen cloth of different colours. Black cloth was always found to be possessed of the greatest absorbing powers, and white of the least; red cloth being intermediate between them. Cottons and silks gave, on trial, precisely the same results, which were further confirmed by the different weights acquired by these substances from the deposition of camphor upon them.—*Proceedings of Royal Society.*

[*Rep. Pat. Inv.*

¶ *Method of Dressing Skins, practiced in Marocco.*

The following account of the method of dressing skins in Marocco, was transmitted to the Zoological Society by W. Willshire, Esq., a corresponding member of that Society, in a letter dated Mogadore, May 5, 1833. Its results are stated to be excellent, as regards the preservation and colour of the fur, and the flexibility of the pelt.

Wash the skin in fresh water to deprive it of the salt; as soon as this is done, scrape the flesh off, when take two pounds of alum, one quart of buttermilk, and two or three handfuls of barley meal, which mix well together, and lay on the fleshy side of the skin equally; fold up and press it together carefully, and let it lie two days. On the third day take it to the sea side, wash the skin well, and when clean and free from the mixture, hang it up to let the water run from it; then take two pounds of alum finely powdered, and throw or spread it equally on all parts of the skin; again fold it up as before, and allow it to lie three days, when it will be in a proper state to dry in the sun, laid flat, without taking away the powder. When it is dry, take a pint or two of fresh water, and sprinkle it upon the skin, and again fold it up carefully for about two hours, to imbibe the water; then lay it upon a table, and after scraping it free from the mixture and flesh, take a sand stone (rather rough) and rub the skin well until it becomes soft and pliable, then hang it in the shade to dry. The process is then complete.

When the skin is perfect, having the head, horns, &c., take off the horns, and fill their cavity with a mixture of equal parts of powdered alum and ashes of charcoal dissolved in water, and expose them two days to the sun. Saturate the trunks of the horns in eight ounces of alum dissolved in water, and fold up with the skin, and apply the same on each occasion when employed in curing the skin. The flesh on the head and jaws to be carefully taken off, filling the same with powdered alum. It should remain in the sun until perfectly dry.

In addition to the foregoing description of the mode used in Marocco, in dressing skins, as related by the persons employed by Mr. Willshire, it may be well to observe, that the process does not take so long at Mogadore, as Mr. W. has often received back skins of the Aoudad and Leopard from the dresser, on the third or fourth, and never exceeding the fifth day, perfectly cured. Allowance has been made by the dresser, in the foregoing description, for the difference in the climate of London.

The skins of smaller animals must not be subjected to so lengthened a process, or they will become harsh and the pelt impoverished—*Proceedings of Zool. Soc.* [*Ibid.*

¶ *Polishing Powder.*

Certain of the French manufacturers of polishing powder, use in their manufacture scraps of old iron, which they put into a tub, and cause to rust quickly by sprinkling with water.

When a sufficient quantity of rust has thus been formed, it is collected by washing, and after allowing it to settle, it is dried and calcined in a crucible.

The longer the calcination is continued, the more the oxide approaches to a violet hue, and the harder its grain. At a very high temperature, the oxide is partly reduced, its colour becomes more gray, and the grain is too hard for polishing.

The red oxide serves for polishing gold and silver, the violet oxide is fit for polishing steel.

When taken out of the crucible it is first triturated, and then levigated, in order to collect the finest parts. [*Ibid.*

CELESTIAL PHENOMENA, FOR APRIL, 1834.

Calculated by S. C. Walker.

D.	H.	M.	S.	
2	5	59	33.5	Em. ♃ ☌ Sat.
9	8	35	30.5	Em. ♃ ☌ Sat.
10	7	35		♃ ☍ ☽ ♃ North 3°.
10	16	42		☿ Stationary.
11	5			♂ ☍ λ Aquarii ♂ South 1°.
14	7	10		Im. ☌ Geminorum, 6, N 65° V120°
14	7	48		Im. ☌ Geminorum, 7, N 32° V330°
14	8	17		Em. ☌ Geminorum, 6, N297° V354°
14	8	30		Em. ☌ Geminorum, 7, N 87° V 27°
16	7	58		Im. 9μ′ Cancri, 6, N167° V210°
16	8	28		Em. 9μ′ Cancri, 6, N219° V273°
18	8	56		Im. (240) Leonis, 7, N116° V131°
18	10	08		Em. (240) Leonis, 7, N296° V337°
22	7	15		Im. 88 Virginis, 7, N101° V 47°
22	8	20		Em. 88 Virginis, 7, N321° V284°
22	15	35		N. App. ☽ and (270) Virginis, 7. ☽ S. 4′.
22	23	7		♀ ☍ ♃ ♃ South 32′.
25	1	29		☿ greatest elong. West 27°.

¶ *Removal of a Steeple.*

The Genoa Gazettee contains an account of the removal of a church steeple entire at Crescentino, in Piedmont, from one point to another, at several yards distance, where it was placed on a new foundation. The master mason was so confident of success, that he made his son remain in the steeple ringing the bell during the operation.

Meteorological Observations for January, 1834.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
☽	1	33°	36°	29.85	29.95	W.	Moderate.		Lightly cloudy.
	2	31	39	.75	.75	SE.	do.		Drizzle—thick fog.
	3	34	41	.95	30.10	W.	Blustering		Flying clouds.
	4	14	19	30.30	.35	W.	Moderate.		Clear—cloudy.
	5	15	21	.30	.12	NE.	do.	0.25	Light fall of snow—cloudy.
	6	13	23	29.95	29.95	N.	Calm.		Cloudy—snow.
	7	10	23	29.65	.85	W. SW.	do.		Clear day.
	8	24	38	.85	.90	SW. W.	do.		Lightly cloudy—clear.
⊗	9	15	33	30.15	30.20	W. S.	Moderate.		Clear day.
	10	30	39	.15	.10	W.	do.		Drizzle—clear.
	11	32	34	.00	29.85	SE.	do.	0.65	Drizzle—rain.
	12	32	32	29.65	.50	SE.	do.		Drizzle—sleet.
	13	31	36	.85	30.05	W.	Blustering		Flying clouds.
	14	22	34	30.20	.20	W.	Moderate.		Lightly cloudy—clear.
	15	23	32	.35	.45	NW.	do.		Clear day.
	16	20	34	.20	.30	NW. W.	do.		Clear—light clouds.
	17	33	45	.00	.00	SW.	Blustering		Rain—cloudy.
☾	18	47	59	29.85	29.85	W.	do.	0.65	Foggy—flying clouds
	19	39	43	.85	.85	NE.	Moderate.	0.10	Cloudy—drizzle.
	20	38	42	.75	.75	W.	Blustering		Cloudy—snow in the night.
	21	29	35	30.00	30.00	NNW.	do.		Cloudy—clear.
	22	17	24	.00	.20	NW.	do.		Clear day.
	23	12	27	30.16	.20	W.	Moderate,		Clear—lightly cloudy.
	24	29	34	.20	.10	W.	do.		Lightly cloudy—clear.
	25	12	22	.30	.15	E.	do.		Clear—cloudy.
⊕	26	30	34	29.50	.30	W.	Blustering		Snow squalls—cloudy.
	27	16	22	29.80	.40	W.	do.		Cloudy—clear.
	28	12	27	30.00	30.00	W.	Moderate.		Clear day.
	29	22	32	.25	.45	W.	do.		Clear day.
	30	29	38	.45	.20	SE.	do.		Lightly cloudy—clouds.
☽	31	32	42	29.95	29.95	NW. W.	do.		Lightly cloudy—hazy.
Mean		24.10	32.35	30.04	30.03			1.05	

Thermometer.		Barometer.
Maximum height during the month,	59. on 18th,	30.50 on 16th.
Minimum do.	10. on 7th.	29.50 on 12th. and 26th.
Mean do.	28.22	30.03